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THE PRACTICAL

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FRANCIS FRANCIS.

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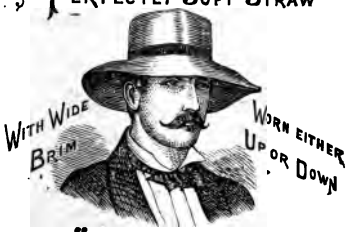


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# PRACTICAL MANAGEMENT

OF

# FISHERIES.

## A Book for Proprietors and Keepers.

By FRANCIS FRANCIS,

*Author of "Fish Culture," "A Book on Angling," "Reports on Salmon Ladders," &c. &c. &c.*

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WITH ILLUSTRATIONS.

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# PREFACE.

I MAY take occasion to say here that this is not an exhaustive treatise on fish culture, intended for the use of experts, but it is a handy book for amateurs, proprietors of waters, and keepers, who may want to know how best to protect and develope their fisheries at the most moderate cost and trouble. I have not, therefore, entered minutely or deeply into the scientific aspects of the question; I have merely given plain and simple rules for rough and ready methods of carrying out the above objects. There are numerous waters, many, very many, miles of rivers, hundreds of pools and ponds, and scores of bigger lakes, which are comparatively wasted for want of the comprehension of what real value and account such waters might be turned to with only a moderate knowledge (such, in fact, as I have given here) of the methods of stocking and managing fisheries. If I can only rescue some of these from neglect I shall be satisfied, and I have not the least doubt in my own mind that when once students and practical persons have mastered this much, they will want to go much further, and will by no means rest satisfied with what they have acquired. Wider and deeper treatises will then be needed, and it is a matter of congratulation that at this juncture we have succeeded in

establishing once more a National Piscicultural Society, under the presidency of the Marquis of Exeter, whose practical interest in such studies is well known. Readers of this little work, whether Britons, Colonial or otherwise, or foreigners who may wish to assist or join in this society, should know that an application to the secretaries, Mr. R. B. Marston and Mr. W. Oldham Chambers, at the offices of the Society, 2, Chancery-lane, will receive every attention. I have thought it desirable to add a few pages as to the construction of salmon or trout ladders and passes, as the knowledge possessed on this subject by the public in general is almost less than on any other subject, and I am so often applied to for information that a little rudimentary instruction can hardly be thought out of place here.

FRANCIS FRANCIS.

*The Firs, Twickenham,*
*May*, 1883.

THE

# PRACTICAL MANAGEMENT

OF

# FISHERIES.

## CHAPTER I.

### FISH AND FISH FOOD.

In dealing with the practical management of fisheries, I must begin at the beginning, and say that, from a national point of view, and as a food and industrial question, we display much worse than no management at all. Our sea fisheries are submitted to the doctrine which the "monks of Medmenham" adopted, of *Fay ce que vous voudra.* Everyone accordingly has done as he liked, and this has resulted almost in the destruction of our inshore fisheries (see Appendix, 1); while as for our inland fisheries, except in occasional instances, where the fisheries are entirely under the control and management of private individuals, the interest of the fisheries is made subservient to every other possible thing that can effect them. Everyone may poison the water who pleases; the laws which have been suggested by the victims to put a stop to this have been manipulated by the polluters, and passed by Parliament in the interests of the polluters, and are a farce, simply making things more difficult than they were before. Inefficient as

they are, with that remarkable irony which Parliament sometimes indulges in, you have, in the majority of cases, to appeal to the pollutors themselves to put them in motion, and, along with them, every other industry which can destroy the fisheries makes common cause against them. That is the hopeful position of things as it stands at present.

To begin with the most important fishery, I must, of course, say something about the salmon. Sir Robert Peel once said that he never remembered a session of Parliament without the introduction of a Salmon Fishery Bill. The same might have been said, out of the necessities of the case, up till now; but the promoters of such useless matters have come to despair of Parliament as a remedy for their grievances, and have realised, too painfully, the fable of the frogs and King Log. There was a time, though, some forty years ago, when, the fisheries being in a very depressed condition, sundry enthusiasts (myself among the number) conceived the wild notion of making salmon as plentiful as it might easily be—forgetting how difficult an apparently easy thing often is when it has to do with vested iniquities. We saw all sorts of folly perpetrated in respect to salmon, and we set ourselves the herculean task of dispelling ignorance and stupidity. We naturally thought to ourselves, Here is a fish that only needs to be allowed to fulfil its natural functions in reasonable numbers, to fill our rivers to repletion with delicious food at little or no cost, and when we demonstrate how easily this can be effected, there cannot be much difficulty. I can smile now when I look back on all my broken hopes, and think how I resolved to be a great public benefactor, and, instead of making two blades of grass grow where one grew before, to make fifty salmon appear where one was seen before. Alas! as the great Dr. Johnson, who libelled our craft so, once said, "Ye who listen with credulity to the whispers of fancy, and pursue with eagerness the phantoms of hope; who expect that age will perform the promises of youth, and that the deficiencies of

the present day will be supplied by the morrow, attend to the history of Rasselas, the prince of Abyssinia." The history of Francis, the prince of nowhere in particular, would aptly be prefaced by these words. If we be asked how far we have advanced towards the object set forth above, I can only say that we are further off it than we were forty years ago; for ignorance and stupidity have increased, and since then have obtained titles to obstruct and pollute which they then did not possess; and, added to that, we have disgusted the upper proprietors, who, at that time, were most friendly to us and the principal supporters of legislation; now they look upon the entire question with suspicion and aversion.

I may here take occasion to say something about the natural history of the salmon, as it is a matter about which there has been a good deal of misapprehension, and, unless the natural history of a fish be pretty well understood, it is not easy to legislate with certainty for its increase and preservation. The salmon enters the rivers chiefly with the intention of spawning, which it does from November to the end of December chiefly. It deposits its ova on gravel shallows, covering it with gravel in trenches, which are called redds. There the ova lies for several weeks, until it hatches, at a period varying from seventy or eighty to one hundred and twenty days, or even more, according to temperature. When hatched it is an alevin, and is furnished with a huge umbilical sac, which it absorbs gradually day by day for some three or four weeks more, when it emerges a perfect fish, and ranges about in search of food. In time it becomes a parr, in which state it remains for about a twelvemonth, when it reaches a size of from four to seven or eight inches long, and then a change comes over it, and it grows a fresh set of scales, much more silvery than the last, which efface the dark finger marks that distinguish it in the parr state. Then it is a smolt, and it commences its first migration to the sea; but all the parr do not become smolts at the end of one year, many remain

behind still, for two, and some even for three, years. This fact gave rise to much controversy formerly, and to the institution of the small species, called Salmo Samulus by Yarrell, because it was held that all the parr went to sea at the end of one year, and they had to account for those which stayed behind; so, to make their theory out, they had to invent a new species. Another belief, too, was put forward, viz., that the young salmon put on the smolt scales as a defence against salt water, and that it could not live in salt water without them, but would die instantly. Indeed, I remember somewhere to have seen an experiment related in which this was demonstrated. Some of our parrs at the Brighton Aquarium, however, did not take on the smolt-scale at the same time with the others, but when the others were perfect smolts they remained perfect parrs. Not being able to separate them without much mischief, we decided to sacrifice the few parrs for the benefit of the smolts, so we turned in the salt water expecting to see the parrs die. Nothing of the kind happened, for, after a little active exercise, they settled down to their regular life like the rest; and, no sooner were these fish well settled than they began to put on the smolt scale, and in a fortnight they were as perfect smolts as the rest, so that the salt water made them change their condition promptly, when naturally they would not have done so for another year at least. But, stranger than all was the fact that among these parrs there was a young trout, which had come from the Usk with them, and even he did not object to the salt water, but thrived and grew more rapidly even than the smolts, and came to be a bigger fish at the proper time. All of them were changed back to fresh water, and again in turn to salt, and they all, including the trout, seemed thoroughly to enjoy the change. Then came the question how long did smolts take in the sea to become grilse? The popular delusion was always that a smolt went down to the sea in May, and came back a grilse in two or three months, having grown many pounds, even

up to six or seven or more; and great nonsense was talked of the wonderful power of increase. Wonderful indeed, when a fish could grow one pound or more a week! For grilse often return in June of six and seven pounds! Subsequent inquiry and experiments in virgin waters showed that, though some grilse might return in the same season, they did not run large, but the majority remained another twelve months in the sea, and it is a question if the larger grilse, those of ten and eleven pounds, did not stay even longer than that. The fact is, that wherever hard and fast rules were laid down they were proved to be wrong, and it was shown that nature had no arbitrary rules for this, but that individuals varied and grew in a manner (not exceptional) but in accordance with the rest of creation, and the return of the grilse as salmon is, no doubt, subject to the same chance determinations; capacity, habit, and growth regulate the rest.

As regard these fisheries, the whole question is included under three heads, but chiefly under two. The first is the necessity for throwing open the rivers so that the salmon can, without hindrance, pass upwards whenever it pleases. The other chief one is in the regulation of the catch; that is to say, the prevention of the nets and engines, which throng the mouths of the rivers, from taking an undue share of salmon. The third consideration is pollution; but as this is dealt with on other grounds than that of the fisheries, I need say little more about it than I already have. To the first consideration the weir and mill owners and manufacturers generally have offered a stubborn and solid resistance. It is to no purpose that you demonstrate that the passage of the salmon need not in the least injure or interfere with the water or milling power—one dogged answer is opposed to every representation, "You shan't touch our weirs;" and, unfortunately, so many of these weirs belong to big manufacturers, and big manufacturers have such intimate relations

with big people as a rule, that you never have a chance of even getting a clause dealing effectively with weirs before Parliament. As regards the fisheries at the mouths of rivers, many of them belong to dukes, earls, and M.P.'s who have very earnest sympathies with "the poor fisherman who earns his bread by," &c. Thus you can neither get the rivers opened nor the nets regulated, and therefore there is little to be done that can at all benefit the salmon fisheries *permanently.* A temporary benefit has more than once been conferred on a river here and there by improved protection, or by some other measure proceeding from the anglers or upper proprietors; but the result has simply been to increase the number of nets when the increase of fish is speedily converted into a decrease again. Were it not for these points, a great many measures of improvement by artificial cultivation, the introduction of new breeds, &c., could easily be carried out, and every river might be made a perfect silver mine. If salmon were cultivated as we cultivate farm stock, it would pay us infinitely better, and it might easily be reduced to 3*d.* or 4*d.* a pound or less; and as for sport, no one would need to go out of the country to find it, for there would be abundance here. But, until measures which are really and permanently remedial are carried out, anything short of that is mere waste of time. It matters not what you do, or how you try to improve them, while the throats of the rivers are in the grip of persons whose only object is to catch all they can without regard to the future. Little, therefore, can be said on this point.

A short space may be devoted to the consideration of the operations carried on at Stormontfield, as they are certainly beneficial to the catch of the Tay *to some extent.* The loss in the hatching of ova and rearing of fry up to the smolt state in a state of nature is very large, owing to the number of enemies which the egg, the alevin, and even the small fry have; and, even when they have arrived at the smolt state,

and are better able to look after themselves, they have several enemies, while still in the river, which take heavy toll of them; in *the gulls* who feed on them incessantly; their own fathers and mothers in the kelt state, who also feed largely on them; mill leets, anglers, &c.; all of which are more or less destructive. But the loss during the ova and fry state is very heavy: all sorts of birds, beetles, larvæ, and other insects preying on them incessantly, while one salmon will often wholly plough up and destroy the nest of another one. The protection, therefore, afforded by artificial hatching and rearing is exceedingly valuable in the present artificial state of the rivers, and gives, no doubt, a far larger percentage of fish than the natural method. The means employed at Stormontfield are simple. A stream is taken off from a mill leet to supply the boxes and ponds; this enters a filtering pond, 60ft. long by 15ft. wide, which again filters into the trough that supplies the various rows of boxes. These are contained in an area of 72ft. square, with a narrow path between each row; they empty into another trough at the bottom, and this again empties out into two ponds, of a quarter and three-quarters of an acre in area respectively. When the fry are hatched and are ready to feed, they drop off the boxes down to the ponds, and here they are fed with boiled liver and other substances till they are matured into smolts, when they migrate again down through hatches opened for the purpose into the Tay, and take their way to sea. There are no means of knowing what the practical result of these operations is as regards the capture of salmon, but it is supposed to be considerable, and it may well be assumed to be much larger than if the ova were left in its natural state. Of course, if an out-of-door method, on a large scale, were thought desirable for any other river, no doubt a similar one could be employed. But beyond that there is little to be done owing to the state of the law. As regards the improvement of the breed of fish, no doubt this

is a question which should be carefully attended to. There is a tendency in all creatures to die out unless the breed is now and then crossed. Look at your grouse disease. Look at rabbit warrens, where wholesale mortality often occurs when the stock begins to get stale. This may perhaps be less noticeable in fish; but still great improvements may be made. Whether it would eventually tend to check the salmon disease (as it is called) it is not easy to say, but it could not do any harm. The great object, in my view, is to get early breeders, as they propagate early breeds. There is no doubt of it; and why you should not make one river that presented capabilities for it, as early as another, I don't know. Look at the Erne and the Bundrowse, only a few miles apart, Their capacities are very similar; both have large lakes for shelter, yet one gives fish in February, and the other not till May. Why not transfer spawn from the early river to the late one? I believe that in time it would answer.

Before finishing with the salmon, there is one more point I want to touch on, and that is the over-preservation of kelts. I am sure that we have overdone this, and that the scarcity of grilse often complained of in some rivers is in some sort traceable to this. A kelt after the month of March, and even, one might say, from mid-March out, is not worth his keep; he is mending condition on his grandsons, and the number of smolts he will eat in a day makes him as bad as any old pike. I would kill all kelts found in the river after the 15th of March. They are not only a nuisance, but an injury. I have long advocated this, and I am glad to hear that quite lately two large Scotch boards have adopted the same conclusion. There would be plenty go down in the early floods for ordinary purposes.

The consideration of trout fisheries is a far larger matter; and as we have the cultivation of our trout fisheries (save where we have admitted the salmon to them, or where they are the heads of salmon rivers) very much in our own hands,

and can make our own laws and rules in respect to them; and as they are a matter of very considerable value, not only as food, but as affording a good deal of employment, and circulating money, in poor localities, besides giving healthy and desirable sport, it is clear what a valuable property fisheries are to all who live near or have to do with them, with any management at all. I shall deal with them more fully; and the first consideration is the trout itself. The notion for some time prevailed that the variation in the same as regards the appearance and character of trout was altogether a matter of food and water, and that if trout of one sort were taken away from the parent river, and placed in another, they would in a short time become like unto the trout natural to the stream; but experience has dispelled this illusion, and trout from the Wick, from the Test, or Loch Leven, if placed in other streams, will certainly maintain their peculiarities for a long time, and even leave their mark on the breed in the river. Of course, if the river trout are in the great majority, the new mark will be less visible, though it may be a long time dying out. It is the same with cattle or sheep, and indeed with every created being. The great object is to improve the breed, and there is no doubt that you can do so by introducing better breeds than you possess into your lake or river. Some breeds grow much more rapidly than others, and therefore reach a larger size than others in less time. Their power of assimilation is superior, and if they can procure suitable food they will grow more rapidly. It is nearly always to be found that trout which spawn early grow more rapidly. For example, the Thames trout spawns in November, and it grows very quickly, and reaches a large size. A Wandle trout does not spawn till quite late in February. The consequence is, the Thames trout has nearly four months' start over the Wandle fish; a Thames yearling will be from six to eight inches long when a Wandle yearling will not be more than two to three inches.

and a pound Thames fish will be about three years old, whilst a pound Wandle fish will be fully four, or even more. There are two things requisite—plenty and variety of food and a good breed of fish. There are some breeds which, give them what food you will, will never grow very big. Of course water has something to do with the growth of fish. Cold limestone waters, flowing out of deep hills, for example, seldom turn out as large fish as streams more exposed to the air, and flowing openly over fat pastures; and this is rather because the temperature of such waters is generally lower, and therefore does not develope food so rapidly.

The prevailing idea that the trout is a creature of rapid streams, and does not suit sluggish ones so well, is a fallacy. Trout like rapid water, though, as a rule, you do not find the biggest trout in it. Of course, in a rough stream just entering a pool you always find the master trout of the stream, because it gives the first choice of food, and if you kill him the next biggest will be sure to take his place; but you will always find bigger trout in the quiet mill heads than you will in the rapid mill tails. And in a pond, if food is plentiful, and there are not too many trout, they will grow more rapidly than even in running water. One thing a trout cannot do without in a river, particularly in a rapid one, and that is a place of rest—a home. There are times when he lies out on the watch for food for an hour or two, or more; but he must have some safe haunt to retire to when he wishes to rest or to hide from danger—some place behind a big stone, in a hole, under a bank or heavy weed, or some rotten old woodwork or twisted roots. Here, out of the stream, he takes his ease, like paterfamilias in his study, and digests his dinner, retires out of the way of heavy floods, and shelters, after the labour of spawning, until he can pick up gradual strength to get upon the gravels again, and cleanse himself from the slime and parasites which usually attend trout in such a condition. Here, as soon as the break of winter per-

mits insect life once more to awaken, he begins to feed, and gradually to pick up strength and condition.

Streams differ a good deal in the times when trout get into condition. This is dictated partly by the date of the spawning season, and partly by food. On some streams, where the fish spawn as early as November, the fish, no doubt, will come into play earlier than in others where they do not spawn until much later; but even in this case food is a question which will very much affect the matter. For example, on the Itchen, on the old barge river *below the town*, the fishing commences on the 1st of March, and it is not an uncommon thing in the first week in March to take fish there in respectable condition; whereas above the town they do not commence until a fortnight later, and it is a rare thing then to find any fish at all in condition, even for another fortnight. Of course, the great abundance of unnatural food which comes from the town and the sewage is the cause of this, as well as of the great abundance of fine fish which that stretch of the river is able to maintain. Some rivers—as in Devon, where the trout spawn early, and the mild climate assists their feeding—fish moderately well even in February, while others again hardly fish well even in May. The Wandle is an example of this, for there the bulk of the fish do not, as I have said, spawn until February, and some even as late as March—a most unusual thing, by the bye, and one I should hardly have credited if I had not seen it, and more than once. Of course, the stock of trout also will affect the early or late getting into condition of the fish. If a very large stock is kept up, the fish, as a matter of course, do not get so much food, and are therefore slower in coming into condition. In cases of this kind, where large stocks of fish are kept, spring feeding undoubtedly could be resorted to as an assistance, and, certain favourable spots being chosen, all kinds of food could be cast in.

And while we are on the question of food, we may as well

go more fully into it. There is no question that this is a matter to which not nearly enough attention is paid. People pile up great stocks of fish until they are in droves like roach and dace, and they fancy that that is all that is required. You must not kill a trout under 11b., and you must not fish with anything but fly. You begin in April and leave off at the end of August; and with such regulations the fish are bound to increase on you, if you have any fair spawning grounds. The more they increase the worse your sport gets. There is an enormous stock—fish every yard, and the angler, good easy man! smacks his lips and thinks what a slaughter he will make, and wonders whether his creel will be large enough to accommodate the take. The next day he comes down to a lovely bit of shallow where he saw such shoals yesterday. As he comes down to the stream (while still fifty or sixty yards away) he sees the fish rising merrily. By Jove! what a hole he will make in them! Up goes his rod, and he creeps down to a fine rising fish; but he does not regard one that was not rising, but has been regarding *him*, and was just under his nose, and who, as soon as he begins to wave his rod, bolts up stream, of course, with a wave like a boat past the rising fish, who takes the hint at once, and incontinently joins the first; thus two waves go up, to be joined by three, four, or a dozen—every fish on the shallow, indeed, until a steam launch would not produce a greater disturbance. Away they all go for shelter—here, there, and everywhere—and, of course, there is no shelter on the shallow; there never is. Proprietors do not think that requisite. A shallow is a shallow, and one is as good as another; so the fish have to go up fifty or sixty yards or so to the deep water above, and the whole shallow is done for *pro tem.*, while the angler stands still, and swears, if he is a choleric man, and looks very sold if he is not. Not a fish will be moving on that shallow for another three-quarters of an hour, and whenever he comes to it the same thing, more or less, will

happen. I have seen it happen hundreds (I might almost say thousands) of times; yet so pig-headed are proprietors and their keepers, as a rule, that I never yet succeeded in inducing one to take any means to ameliorate such a state of things. They seem satisfied that the fish are there, whereas they might as well not be. If there were a dozen or a score of fish on that shallow, with proper shelter handy, you would bag a brace or two; but, as there are three times that, and no shelter, you do not bag one. Now, that is one result of an overstock. This may be mitigated in some respects, if you scatter plenty of hiding-places about over the shallow, so that a fish may not have to scud fifty or sixty yards or more to find a hide. If he has a hide within three or four yards or so he simply pops into it, and disturbs nothing; and, added to this, a fish is far bolder when he knows he has his home close under his lee than when he is fifty yards away from it, and constantly on the look-out for a bolt.

The question of hides is another question which I shall treat presently; meantime, I must retrace my steps a little. Well, that is one result of overstocking; another is, that the fish will not endure to be crowded, but as soon as ever the spawning season begins to loom in the distance, away they go in a crowd up stream, or into any little easy-to-poach tributary they can force their way into—anywhere, away out of "the madding crowd," and you lose a large portion of your stock, and so nature avenges herself. Fish will not be overcrowded if they can avoid it. They cannot feed comfortably, and there is not enough food for them, and therefore they will go if they can; and it is always the best that go, the large ones, not the little ones—they stay where they are, but the big ones clear out, and, if they cannot, then your fish fall off in condition. You find a lot of black beasts in your water, which are more like eels than trout; there they are all the season long, not worth twopence for either sport or table. Every fish of this sort should, if the proprietor is wise,

be taken out, and either put in a stew if there is any chance of his mending, or made away with if there is not. They never get into condition if left in the stream, and, for the most part, become wretched cannibals, who live by feeding on their own sons and grandsons. Out with them at once, for they do more harm than any pike; and lastly, the stock gets smaller and smaller, and where you used to get nice, well-conditioned pound or pound and a half fish, a fair half-pounder is a novelty, while you keep on whipping out stores by the dozen; and the worst of it all is that, when you do find your mistake out and try to amend it, you cannot. For you will find that your over-stock of fish have actually produced a sort of permanent famine, by eating up all the stock of insect life, larvæ, and all, which produced the flies and other food on which they lived. If you put sheep on a pasture and starved them, so that they ate up the very roots of the grass, you would easily understand that until you sowed and grew more food you could keep no more sheep; yet you cannot or will not apply the same rule to an over-stocked stream, and you will not till nature shows it to you forcibly. The *value of your stream is in the ratio of the food it produces*, and not an atom beyond. If it produces no food it is valueless.

Now, I am not stating one word in all this which I have not seen take place under my own eyes again and again, and in all parts of the country; and, no doubt, there are many experienced anglers who will concur in every word of this. Unfortunately, however, there are plenty of proprietors who are not experienced anglers, and others who are not anglers at all, but simply leave matters to their keepers; and keepers' ideas are limited—very limited—and if you were to say to a keeper, "Take just half of your stores away out of your water and sell them to someone else," he would look upon you with inexpressible feelings of disgust. "What, net out *his* stores; where's the stock to come from? Reduce the

numbers! Never!" he would perish first. Certainly, if you had more lambs than you had keep for, you would do so I suppose. Well, if you do not do that, then you must feed, and feed largely. A certain area and body of water will not produce more than a certain amount of food, and if you want a larger stock of fish than that natural amount of food will reasonably feed, you must either provide it or see your stock deteriorate; and it does not require anything but a little common sense to determine whether you are keeping too large a stock or not. I could tell in half an hour whether this were the case or not on any stream, always provided that the stream is not infested by pike, because they will cause fish to be in the most wretched condition from actual fear, the fish not daring to come out and feed, save at night, although the stream abounds in food. If your fish get into condition *fairly early*, and are really mostly fat and well fed by mid-June, you are all right. But if, on the other hand, you find a lot of poor lean fish in your water then, you are all wrong; and, if you do not take means at once to learn why this is, your fishery will rapidly go to the bad, as many an one has. How often does one hear, "It was a famous water formerly, sir; I remember taking in one day fourteen brace of fish that averaged 1½lb. apiece, and now you may fish it from end to end and not get a fish of a pound;" and every kind of reason is assigned for this but the right one. A stream should never be fully up to its possible limit in regard to stock, a little under will give you bigger and better fish.

# CHAPTER II.

## HOW TO GROW FISH FOOD AND TO MAKE FISHES' HOMES.

As I have said, one of the most important considerations (to which at present no consideration at all is paid), to both proprietors of fisheries and keepers, is that of the food supply to their stream. Neither keepers nor proprietors pay the slightest regard to it now, and that is why I am rather persistent upon the point, for it is of more importance than the generality of people are at all aware of. The *natural* advantages of a stream in this respect will make all the difference between a good fishery and a bad one. But these natural advantages can be very easily affected by circumstances. Fish feed naturally upon a variety of matters—worms, water insects, flies and their larvæ, gammari, shellfish, young crayfish, minnows, little frogs, and other things. Where there are mills, a variety of beetles, grubs, cockroaches, meal worms, and such matters, help still more to feed the fish, and the neighbourhood of a mill-wheel is a very favourite lay for fish. Now some streams naturally produce more of one kind of food of these different sorts than others, and the great thing to study and learn is to what natural circumstances these advantages are owing; whether to the nature of the soil, the temperature of the water, the kind and quality of the plants that grow in the river or along the banks, or to the productive nature of the food itself and the capacity for breeding it.

To give some idea of what I mean, I would refer to some portions of the river Test and other rivers I could name. There are in places great areas along the banks where the

stream overflows, and there are acres of rushes and reeds standing a foot or more deep in water and slush. Here you find the very biggest and best fish, and the reason is palpable. These squashes breed food; and if there is abundance of food, your fish will be naturally fine fish, and will soon get into fine condition; but if it is scarce they will be small and in poor condition.

As I have said, circumstances of course can affect and alter this more or less. Heavy floods or very inclement weather will often destroy large quantities of the larvæ of flies and insects. They get into the gravel, a heavy flood will shift the gravel or deposit mud, and either crush or smother vast quantities of insect life. Weed cutting constantly, harrowing the river, and pollutions of all kinds, all more or less affect the food of fish. Very hard winters, with ground ice, &c., will also kill large quantities of the larvæ, and very cold and frosty breeding seasons will heavily affect the flies of various species. Most flies after they emerge from the larva or pupa state live some days on the banks, during which many of them change their skin completely. They come out as what the angler terms "duns," and they shed their coat and become what he calls "spinners," and until they have done so they are incomplete insects, and cannot breed. Now, if at the time when these incomplete insects are on the land, severe weather occurs—sharp frosts, or what not—the flies die before they have a chance of breeding, and the next season, of course, there is a scarcity of that particular fly, and it may be many seasons before it recovers, if ever. This is one way in which, to my mind, the greendrake or Mayfly has died out altogether in so many places; and where there are only a few stragglers left, the swallows and other birds pick them up as soon as they get off the water, and thus none are left to breed; and we are running our hobby of bird preservation so hard that we shall starve our fish, if we don't take care, for the sake of the birds.

Now, if you want to supplement the food of your fish,

there are two ways of doing it—one very troublesome and slow, but invaluable in the end, and the other rough and ready, and always at hand. For my own part, I should, I think, adopt both. The first is to introduce natural food which would breed and increase in the water, and the other to feed by casting in worms, gentles, chopped meat, mussels, liver, bread, fibrine, shrimps, and a variety of matters. Take the rough-and-ready plan first. You can always procure something which will feed trout. Boys can pick and store worms, minnows, cockroaches, small frogs, &c. You can purchase mussels, on which they feed largely at Howietoun, where they also use liver or horseflesh; and you could, no doubt, purchase by the bushel the small shrimps which are sifted out by the Thames-mouth shrimping boats as useless for the London market; and I am of opinion that this would be found most invaluable food for trout, as it would not only fatten them greatly, but would avoid giving that nasty rank stale flavour which too much horseflesh or liver causes. But there are a great variety of matters which trout will feed on, and which a sharp boy could easily collect in considerable quantities, and by the aid of which you could feed trout.

The diet on which trout thrive the best is composed of flies and their larvæ, beetles, small shell fish, and the gammari or those small fresh-water shrimps which abound in many waters; and it is to be noted that where these gammari are most plentiful there the trout are nearly always the largest, and of the best colour and condition. I have often opened trout and grayling, and found three-fourths of the food in their stomachs to consist of these small crustaceans. Trout fed exclusively on worms or small fish do not get into the fine condition which they acquire if these matters are added. Such food is an excellent stand by, particularly for big fish, but variety is what is really needed, and it is of the last consequence to a fishery to have plenty of flies of various kinds, plenty of gammari, and a good stock of water snails of various

sorts. Open a Loch Leven fish, and you will find that a very large part of his food consists of very small water snails—"buckies" as the Scotch call them. These subsist largely on a water plant which abounds in the loch.* And there is no difficulty at all in transplanting the plant and the food to any other water. You could convey it any distance; and so with the gammari. If you go to a favourable place you might collect gallons of them, and if they were turned into the small ditches and carriers which run into your stream they would no doubt increase rapidly, and soon stock your water. Now, in all streams there are carnivorous creatures, such as these gammari, some of the shell-fish, as the *lymnea* (a sort of small fresh-water whelk), crayfish, and others; and it is of importance to provide them with food in turn if they are to increase and multiply. No better medium of this kind can be found than the big fresh-water mussel, called the unio, which abounds in many streams. I got a hint of this once on the Thames, where in places they are very plentiful. I picked up a dead one just below Sunbury Weir, and, when I opened it, it was half eaten by some scores of gammari, which were feeding fat upon the carcase. There is not the slightest difficulty in introducing some bushels of these; and, if you like to introduce the *margaritifer*, as the pearl-bearing unio of the Tay, Teith, and other rivers is called, you may also introduce a new value to your stream. They often produce magnificent pearls.

Now, streams vary in the flies which they produce. Some

* This water plant is a very pretty little mossy-looking weed, the *Chara flexilis*. Whenever you pull up a handful of it, you find it covered with small mollusks, which, for the most part, belong to the *Bythinia* and *Hydrophia*. The fish are wonderfully fond of them. Now, there would be no difficulty whatever in transplanting specimens of this plant, and of the mollusks that subsist on it, from Loch Leven to any other lake or pool, and it is strange that no one ever appears to think of any such undertaking.

streams have Mayfly, or had it formerly, in such abundance that your trout simply fed and fattened on that one fly. Formerly I have often with the artificial fly taken out a trout which was feeding so rapidly that he hardly let a fly pass him, though the water was covered; and although at that time his stomach was crammed and distended almost to bursting, his mouth was full of flies, which he must have had much ado to swallow. Yet, with the flies absolutely dropping out of his mouth wholesale, he took mine. One can understand fish getting rapidly into tip-top condition when they feed like this; but it is a most singular thing, and how to account for it I do not know, the trout do not feed like this of late years. I have seen very fair rises of fly on, but the trout hardly ever seem to care very much about them. They pick up one now and then, and let eight or ten pass them for one which they take; and as for being stuffed to repletion till the fly drops from their mouths, I have seen nothing like that for many years. They often come up and rise at the natural fly, and refuse it. So they do, for that matter, at times at the duns; and unless it be that the schoolmaster has been abroad, and has tutored them, so that they begin to be afraid of flies altogether, or no, I cannot say why this freak has come upon them.

One thing I am quite sure of from autopsing their stomachs very often, and that is they feed far more on larvæ than they do on fly. Dozens of times, when I have seen the fish apparently rising fast in all directions, and I have been unable to get hold of one in a hundred, when I *have* taken them they have been full of larvæ. They take it just as it comes to the surface to burst into the fly state; and I think I have noticed this practice largely to prevail where the water is very well fished, so that it is possible that the fish have learnt that larva is safer food than fly; and, if so, this would account for the shyness of fish at the Mayfly.

But there is no doubt that Mayfly is nowhere as plentiful

as it used to be, and in dozens of streams it has disappeared altogether. Then there is a most excellent large and valuable fly in the stonefly that comes on in April or early May; and, whether in the creeper (larva) or fly state, it forms a most excellent food for the trout. It is big and succulent, and helps to put condition on the fish. Then, again, there is the grannom, another April fly of great value where it is found; it often abounds in profusion, and for a fortnight at least the fish gorge on it. It is a most valuable fly. I have seen it on the Test in perfect clouds, and I believe that the fine size and condition of the Test fish has some *rationale* in the abundance of this insect so early in the season.

Now, all these flies are easy to transplant from place to place, and, I should say, not difficult to acclimatise. They only want a little common-sense, care, persistence, and some small expense. The Mayfly you could easily collect in any numbers during the season in places where it is found. When a good rise is on, a couple of boys might easily catch a basket of a thousand or two. Of course, if you want to stock a part of a stream with a new fly, it is of no use to go once or twice, and just do the thing anyhow; you must exercise great care in turning the flies down, choosing some nice sheltered spot where they can get safely out of harm's way, and you must do it day after day, so as to keep up the stock, and probably for two or three seasons, till you get a good stock of them firmly established; when all you have to do is to keep the birds away (a few charges of blank powder judiciously expended will go a long way towards that), and you will effect your object. Then, again, as regards the stonefly, that is even easier to transplant. Where they are found, boys will collect you any number of creepers, and they will travel any distance in wet weed. You might have them sent from Carlisle to Hampshire, for that matter, then deposit them on the shores of some favourite shallow, and a thousand or two will soon make a stock there, and spread to other parts of the

river. Finally, as regards the grannom, a man with a butterfly net could sweep up two or three thousand a day easily at Stockbridge, and, with care and a proper conveyance to put them in, you could easily send them fifty or one hundred miles. I do not say that you are going to do any of these things without tronble and perseverance, and even some expense, but when they are done they are worth it all, ten times over. If once well-established, the grannom, stonefly, and Mayfly will each give you good sport, and the fish good food for a fortnight or so.

The great thing, as I have shown, to encourage in your fishery, if you want fine fish and plenty of them, is food which is reproductive. You can't have too much of that. Another thing, too, is a matter of some moment as regards food, and that is, you must have some shelter within handy reach of the river. A tree, or a big bush here and there on the bank, not only is a great food producer in itself, but it is a great shelterer of food; and where there are trees and hedges handy there will be food, and flies. Of course, one does not want too much of that to be always in your way, so as to make casting a labour and a nuisance; but a bit of shelter here and there—a bush or two over the stream, which is always a safe find for the biggest fish in the stream—is always useful and desirable, for it is insectiferous, and will be found very advantageous as producing food. Of course, both trees and bushes should be placed judiciously—a tree need not necessarily be a nuisance if kept properly trimmed. They very often are, however, if planted by injudicious people, and not kept from intruding their arms where they are not wanted.

It is singular how some anglers hate every bush and tree, and would denude the bank of all such interruptions. It is a great mistake, as I have constantly noted an over-hanging bush is nearly always a find for one or two or more good fish, and if you can contrive that it should be placed just above a

slight eddy, where food might hang, it is a certainty. I remember just such a place in the stream up at Worthey, above Winchester, and another on the lower Anton water. There were always one or two good fish, the best in the stream, behind those bushes, and they were always free-rising fish, and not easily alarmed, as fish mostly are when they have their home close at hand: and the places were clearly desirable tenements, for if you caught a fish there to-day, there would be sure to be another there to-morrow. Well, one winter the sapient keepers on the other side took it into their heads to trim the banks up, and to cut those bushes away completely, and spoilt the places, of course. Had I the sole management of a stream, I should certainly plant bushes here and there, where I thought them desirable, selecting some quick-growing easy-to-break-off stuff. If they grew too luxuriant or intrusive, a small saw or a bill-hook should be freely applied. And if there were an eddy alongside, and a hollow bank just below, with old roots interlacing, &c., for shelter, the place would be a sort of Eaton or Belgrave square for big trout. Besides this, a pollard-willow here and there, also, is a very useful thing, and even profitable to the landowner. They are very easy to plant and grow, and, if not too frequent, they are useful in a variety of ways; but it is the practice oftentimes to plant them so close that you can hardly fish between them.

Now, I wish particularly to impress this fact on my younger readers. You cannot have big trout in your water unless you have homes for them. For twenty years and more I have been preaching this doctrine to my friends of the Thames Angling Preservation Society, but without the least effect. For years the Conservancy and others have been rooting out all the old stumps, abolishing the old camp-shots, replacing these and the old wooden hollow aprons at the weirs with solid blocks of concrete, which afford no shelter at all or home for the trout, and converting the river more or less into a canal with

a level and smooth bottom and sides, making the broken hollow banks nice trim sloping lawns, until there is, literally, hardly any shelter for good trout left. Formerly old punts, too, were sunk in most of the angling deeps to a considerable extent. There would often be as many as seven or eight in a deep, and one or two of these would always have a good trout in it. Comparatively few are ever sunk nowadays, and it is perfectly useless, as I told my poor old friend Ponder over and over again, to keep putting trout into the river if you don't find lodgings for them. They only drop, drop, drop, until they get into the tideway, whence they never return; but the same stupid plan is still pursued, and the result is patent.

So it is with smaller rivers. The better the holt or trout house, the bigger the trout that lives in it. It is much the same with human beings; the biggest takes the best of everything. A moderate trout will put up with a hole under a weed, but your three or four-pounder likes something more palatial—a fine hatch hole, or a deep hole with an old stump in it, or hollow bank with roots, &c., and this he *will* have, even if he has to live fifty, sixty, or seventy yards away from his regular feeding ground to obtain it. How often one sees a good fish feeding up to his ground, taking a fly here and another there a yard farther up, and so on till he reaches his feeding station. You may sometimes get hold of a good fish when he is feeding up to his larder in this way; but, if you are sure that you have covered him once or twice, and he has refused, don't bother him, as you will do more harm than good—let him get to his station and get well on the rise before you try him again. If you disturb or frighten a fish like this, see how he scuds back to his lair, alarming every fish on the road; and therefore it is that a multiplicity of hides and refuges are requisite if you want your fish to rise boldly and show sport. The more I see and experience this, the more certain am I that this is a most important point in respect

to your chance of getting sport. Every angler of any long experience knows how much easier it is to catch a fish which is rising close under a bank than in the open mid-stream. In the one case his holt is close to him, and he has confidence from that fact, in the other it is several yards off at least, and that makes him timid. A friend, who is a decent fisherman, was telling me the other day how the fish in some parts of the water which he went to would rise and take boldly, while in other parts they were very shy of taking. Knowing the water well, I at once set out the reason, which had not occurred to him, and he was wondering how this was.

Now, there are many streams where good secure holding places for the trout are matters of considerable difficulty. If you can get plenty of good hollow banks, with old roots, &c., protecting them, and plenty of rat holes, you are all right, because no net ever can work them, and the trout are quite secure. One of the best hides, and at the same time the best protection against nets, is a big irregular brick burr. At brick kilns one can often get cartloads of these, where a dozen bricks have become fused together in a solid irregular lump. If there is a hollow side to it, or a hole, lower it with the hollow undermost on the head or tail of some shallow. A few dozens of these judiciously placed are invaluable to a fishery. They stop the nets, form hides for the fish, and often make nice dimply ripples, in which the fish rise freely; in fact, each one, if well placed, makes a very certain and very sure cast, as well as a hide and a protection. But there are two people who object to them, the miller for one and the keeper for another. Either one of these is bad enough to deal with; but when they run together the position is apt to become worrysome. The miller, of course, says that they stop the water and interfere with the mill power, and they catch the weeds, and thus increase the evil. There is just the faintest show of reason in this; but if the keeper would simply put on his water

boots, and, wherever he saw weeds collecting in such places, would hook them off, there would be little grounds for that complaint. But that is a little extra trouble to the keeper, and that he does not care about (see Appendix, 2). Then, too, when you go to cut the weeds, unless you first remove your burrs on to the bank, or trim the weeds round them with a single scythe, they will prove awkward obstructions, and so cause more trouble; and thus it is that you can rarely get either keepers or millers to see the real beauty and efficiency of good big burrs. Now, every case must rest on its own merits; for there are no two mills, though there are a good many millers, alike in this respect, and you must deal with them as best you may; but if your *keeper* wants to save himself any trouble at the expense of your sport, sack him and get another, for he is not worth keeping. The same may be said in all respects of stakes driven in to protect your water; but I shall come to them presently.

There are cases, I fear, which you cannot get over. I remember one in particular on the ——. The miller was the most pernickity fellow I ever came across. There was a charming but quite bare and unbroken shallow some distance below his mill, and out of this he had picked every stick, stock, and stone as big as a shaddock—not a stake or weed or burr would he allow there. "It backed the water in on to his wheel," so he said, which I believe was simply rubbish. I think he was jealous of our having the fishing. But he was a Quaker, and Quakers are often crotchety folk, with the spirit frequently moving some of them to do disagreeable things. However, he was master of the position, and if we put anything in, he promptly took it out again; so I devised remedies. The banks were not at all hollow, so we got a lot of circular and T and Y shaped junction drain pipes,* some

* It is not necessary to get the best of these; you can purchase seconds, which are a bit spoilt in the baking, for half the money.

six inches in diameter, and, boring holes in the banks, buried these tiles in them up to the mouths about every twenty yards or so; then we got three or four square platforms about four or five feet square of inch-thick elm plank, ran a broad iron band across each end to keep the planks together, each end of which band terminated in a rough spike with a harpoon barb about eighteen inches long at each corner, the whole forming a sort of table with iron spike legs. Then, taking these on to the middle of the shallow, we selected a good place, about two feet or so deep, and, placing the boards in position, gradually jumped the spikes down into the gravel, till the whole board lay flat on the bottom, where Broadbrim could not by the most ingenious twist of perverse sophistication make it out an obstruction. Then, going to the lower down-stream end, we got to work with the hoe, and hoed and raked out the gravel under the board until we made a biggish hole, about six inches deep, under the board, and, by doing the same at one or the other, or both sides, we gave the fish three entrances—the top-end, of course, we did not disturb. There was room for ten or a dozen fish under each of these hides, and, after a time, when they had been well-seasoned with water and slime, the fish took to them. A fish can lie in one place in a sharp stream looking for food as it comes down; but he can't do so for ever, for it is not done without an effort; and after a fish has had an hour or two of hard work thus in filling his stomach, he wants a quiet resting place where he can comfortably digest his collation and muse upon the mutability of piscatory affairs; and whence, if he likes to put his head out, he can survey the world of waters at his leisure. Fish are much more fond of the *dolce far niente* than we give them credit for. Whether they really sleep or no it is very hard to say; some fish rest and bask far more than others, as my experience of the Brighton Aquarium tells me.

## CHAPTER III.

### ON THE MANAGEMENT OF WEEDS AND THE ECONOMY OF FISHING.

As I have said, a few old broken drain-pipes laid about on a shallow will also prove excellent temporary hides; but they are apt to fill up, and require looking to now and then. There is a plan which I have seen adopted on two or three waters, notably the Duke of Bedford's at Chenies, and the Duke of Rutland's, on the Lathkill. They are wide, open, and often shallow waters, destitute of shelter, and, being very clear, and quiet, would give but a bad chance to the angler. Here and there a sort of small artificial weir has been made, with two or three fir poles laid across the river, and half a dozen short stumps driven into the bed to support them. The gravel is then dug out a foot or so here and there below the poles to deepen the water, and make holts, and thrown up above them towards the sides; and over these runs a very pretty ripple, which lasts for a dozen yards or more, and makes a nice rising place, while the poles are a partial shelter for the fish. Thus is made a valuable piece of fishing out of a mere barren, useless stretch, and these weirs are repeated every sixty or seventy yards or so, and are an immense improvement to the water; capital sport I have often had in them when, had the stream been left in its natural state, I should not have caught a fish of any respectable size.

Sometimes I have seen this kind of weir with a cut in the middle of two or three yards wide, through which a fine stream sweeps, in which good trout lie; and this is a good plan, too, as it gets together better trout, lengthens the ripple, and

makes eddies; and next to good resting places trout require good feeding places, such as eddies beside a good strong stream into which food is swept. Weeds are excellent things, but it is quite possible to have too much of a good thing, and too much weed is as bad or worse than none at all. Nice runs between the weeds are always famous places for trout. In places like these, 4ft. or 5ft. wide, trout love to rise, and they rise and take boldly. Whether you get them out or no is another matter, for nothing requires nicer skill than to run a good trout down such a place while he is a dozen or fifteen yards off you, on the other side of the stream, with a heavy bank of weeds between. It is to be done, however, and I have done it very often; but it needs very nice handling of the rod, as the least bit too much strain hauls him into the weeds, while with too little he won't lead at all. When I see a man do this well, I regard him as a past-master. Trout are very fond of such places, as the weeds form good shelter, and the food is concentrated in the narrow stream. A nice patch of gravel some two or three yards square, with a big weed handy just above, is always a favourite feeding place for a trout or two. A shallow below a bridge, with good stout old wooden piles to get behind, is always a most favourite larder, fish are wonderfully fond of an old bridge or an old hatch hole; and in the just management of a stream great judgment is required in the disposition and cutting of the weeds, you don't want too many weeds, but you must have some just to give shelter, and to make the water dimply and curly, to promote rising.

One of the worst reaches we had when I first joined the Andover club was a straight shallow bit between Rooksbury Meadow and the big hatch hole. It was flat, stale, and unprofitable—beautifully clear clean gravel, some 18in. deep, and held two or three half-pound fish, with now and then a pounder, which one never could rise, because you never could get near them. By allowing a ridge of weed to grow down

the middle, with breaks here and there, and a nice stream under either bank, that came to be, and is now, the nicest and freest rising bit on the whole fishery, lots of fish of from 1lb. to 2lb., and an occasional bigger one, might be caught in it, and I once caught seven and a half brace in that reach alone, of fish from 1lb. to 2lb. each; and the number of times I have been smashed on it—for the stream is very sharp, and the fish know uncommonly well the use of weeds—I should be ashamed to say. This just shows how a bit of useless water can, by decent management, be made into a first-class bit of fishing.

A weedy river is always more or less of a protection to fish, but a river overgrown with weed, with no open spaces, is by no means a favourite place. Fish never take well when they are lying on the top of weed. They are pretty close to the surface, and there is something in reflection which makes them wary of gut. As my friend M. says, they will not take well on a parsley bed; and he is quite right; a bit of gravel about six feet or more square amongst the weeds is their special fancy. Weeds are a great protection against netting. It is very hard indeed to catch trout with a net in a weedy river in the day time. A shoe net will take fish out of single weeds, or a pole net will take them out from under banks—more or less; a fine thread or silk flew is very deadly on open shallows at night time. These are not easy things to prevent or to provide against, which shows the desirability of having shelter on your shallows. Some people also object even to stakes, as catching the weeds, and preventing the weed-cutting.

A first-rate thing is an old waggon-wheel. Let it soak till it is waterlogged, and then stick a few tenter hooks in it, and drop it into a hatch hole, and it not only catches nets, but the trout get under the spokes, &c., and find good shelter there, while food of all kinds collect about it. We had two in what we call the baby hatch (from a dead baby being found there) at Andover, and one day, after heavy water, I found that one of

them had been driven out of the deep, right on to the edge of the hole in the shallow. I walked in, lifted it, turned it over, and pushed it down again into the deep, and I never saw anything so smothered with food—caddis, leeches, larvæ of all sorts thronged the wheel all over; it was a tremendous trout larder. No wonder the trout do not rise well in that hatch hole. You may see a score of big ones up to 3lb. there any day, but rise them you cannot.

Now, the cutting of weeds is one of the burning questions of the day with anglers; for, owing to the deluging of rivers with sewage, the weeds grow so rankly and rapidly now, that in many places weed-cutting has become so incessant that it very seriously interferes with the rights of anglers. In many places it is not too much to say that at least two days a week throughout the fishing season (or one-third of it) is lost to anglers by reason of the cutting of weeds. Every proprietor of a water has a grand field day or two, or even more, about three or four times every season, and cuts the whole of his weeds from top to bottom, or rather, more often, from bottom to top; and, as he does not take his weeds out of the water, but allows them to float away, not only is his own water impeded for two or three days, but everybody else's below him is put to a like inconvenience. If this were confined to one or two people it would not be so bad; but when it comes to ten or a dozen all cutting their weeds on different days, the unfortunate lower proprietors are terribly pickled by it. Day after day, and week after week, on some waters the angler comes down to the stream to see it covered with masses of weeds, rendering the river practically unfishable; and perhaps on the only days when weather and water have combined to give him a good chance of sport, such as you do not get six times in a season, he sees a good rise of fly on and fish rising freely, he is quite unable to fish them. It is true that you may at such times with a dry fly *hook* fish, but landing them is quite another affair. Only last season, under such

circumstances, I hooked four big fish, from 1½lb. to 2½lb. each, and lost every one by the fouling of the line with big masses of floating weeds. Nothing can be more trying or exasperating to an angler than this, particularly if it is to happen often; and, as this nuisance is manifestly increasing, there can be no doubt at all that it will anon seriously interfere with the value of fishery rights, for anglers will not continue to pay for a privilege of which one-third or more is withdrawn from them in this way. In Hampshire particularly this is a heavy grievance, and the question must be considered how it can best be met and mitigated.

There are three ways in which more or less can be done; but, unless the proprietors are united, and willing to help each other, the question will remain a difficulty. First, you can get the various water owners to arrange to cut at certain, instead of uncertain, times, so that as many as possible should cut at the same time, and the work be sooner over, and the nuisance of shorter duration. Next, you can combine together, and by a small payment at certain places on the river where racks exist, have the weeds hauled out, and, after they have decayed, place them on the land, where they would form a valuable dressing. And, lastly, you can—and this is the best way, if it be practicable and if the keeper will fasten his attention on it—by cutting passages constantly at the sides, and topping the weeds in the middle, reduce the nuisance very considerably, and perhaps avoid any great series of field days. It might be reduced to the minimum of annoyance if the keeper would cut some every morning for a couple of hours before breakfast. These might be stopped for the day at the next mill and turned loose at night. I think this might be done; and, of course, a certain amount of harrowing up the roots should be done every autumn. But there is one point I should like to have determined by law—viz., what right has any person above me to injure my fishery right by sending his weeds down over my water? In some

cases there may exist something in the nature of an easement by long usage; but it would be very desirable to ascertain the extent of that easement, because it would be quite possible for a proprietor to constitute himself such a nuisance to those below him as to very seriously injure the value of their property. I have elsewhere related a story of how two proprietors having fallen out, the one who dwelt above the other always cut his weeds and raked the bottom on the days when the man below him came to fish, and so utterly destroyed his sport. Now there must be some law to meet such cases as this. You cannot injure another person's rights of property without his having some means of calling you to account for it. Weed-cutting is a very troublesome question for keepers when left to themselves. The cutting of weeds close throughout a fishery is a most objectionable process; enough for decent shelter should always be left.

The time, too, when you should cut the weeds ought to be judiciously chosen. There are times, as just before you are expecting the rise of some fine fly, when you certainly ought not to cut the weeds; and always bear this in mind, that if you have good fish in your water, and you cut your weeds *bare*, your fish will not stay in it; they will simply head up-stream till they find a length where there is weed to their taste. An acquaintance of mine formerly, who had some nice water on the Test, which ran near and above some very fine stretches of Lord ——'s, had noticed, with a longing eye, a rare stock of splendid fish in this water. He went to the bailiff who managed the land, and complained strongly that, owing to the weeds not being cut on Lord ——'s, it backed the water so that it could not get away quick enough, and some of their land was flooded. That was not a very uncommon state of things, and as a rule they put up with it; but it was a sore grievance this time, and of course "they wanted to cut their weeds, but it was useless to do it until the weeds below were taken out." Lord —— unhesitatingly

ordered the weeds to be cut. My friend then trimmed his just moderately, leaving, however, plenty for shelter. All Lord ——'s fine fish headed up into his water, and he had lovely sport out of them, but they were not to be caught in that way next year.

As I have said, what a trout likes is plenty of weed, with a bright gravel patch of 6ft. or 8ft., or even yards, square every here and there, so that he can have a bolting place handy, but can be on the open and have a good look-out all around, and can scour his scales on the gravel if parasites affect him at all. A shallow, with a hole here and there, with shelter in it, and patches of weed and gravel alternately, will be a very select fishing place; and yet one constantly sees long, bare shallow reaches about a foot or two deep, where, if you do find a fish or two, they won't take, because they can see and be seen any distance off, and are too exposed; and if a fish gets in such a place, as they often do, you cannot get near enough to fish him properly. The shallow, therefore, is almost useless, yet it would be easy to make it a first-rate place. Take a spade, walk on to it, pick out a suitable spot, and dig a hole about a foot or eighteen inches deeper than the bed of the shallow, about four or five feet long and two or three wide. Then near the upper end of it deposit a couple of big brick burrs, or a pile of big stones, just near enough to the surface to make a nice ripple, and repeat this process in half a dozen or more places all over the shallow, and in a very short time every one of those holes will contain a good rising trout or two. If you like to drive a small stick in at the top of the hole, and lodge a streamer of weed around it for shelter and shadiness you may improve it and increase the chance of sport.

Every trout stream may be enormously improved by judicious management; and if these things which I have noted are not to be seen on a shallow, gentlemen should insist on their keepers providing them, and they will treble

their chance of sport by doing so, There is no end to the improvements you may effect. You may (supposing there be a decent supply of water all the year round, for that is a *sine quâ non*) turn a bad trout stream into a good one by judicious cultivation; and I have no doubt whatever that when the art of pisciculture is thoroughly understood and practised, it will be a profession in which wonderful effects will be produced; but a great deal will have to be learnt before then. To show what can be done by artificial feeding, I may say, as I often have before, that I have seen in one small pond not more than seventy or eighty yards square as many as eighteen hundred magnificent Loch Leven trout, in splendid condition, and ranging from 2lb. to 7lb. weight each. These fish were in perfect health and superb condition, but I shall refer to them again hereafter. If by artificial feeding it is possible to keep going such a stock as that in such a space of water, what might not be done on rivers and lakes of a hundred times greater capacity? It is clear that the production is a mere question of computation and cost, and there are actually no other bounds to it. There is hardly a suburban villa of any pretensions where there is a pond of any size attached to it, and which has any supply of water in reason, where any number of the finest trout might not be cultivated; and certainly no person of wealth or position need ever be without a plentiful supply of the finest possible trout at his door if he chose to have them there. Sergius Orata is said to have cultivated oysters on his housetop. I don't believe it; but there is no doubt that the bounds of pisciculture are of vast capability in the way of extension, and the time will certainly come when all this will be as easy and simple as keeping fowls in a wire pen is now. When I see nice pieces of water on gentlemen's lawns, which are so capable of being made charmingly productive, clogged up with mud and weed, decaying vegetable stuff, and a lot of carp, tench, or roach, which are neither good to eat nor to catch, I feel it as a sort

of personal injury, for they might so easily turn their waters to a really good account. Here and there the management of a trout fishery is understood to a small extent, and a decent crop of fish is obtained; though that this might be very largely increased by skilled management I have no doubt whatever. But in the majority of cases nature is not only left to herself, but is injuriously repressed.

In other fisheries we seem bent solely on destroying them. In the salmon fisheries, which might be so valuable, the result is patent to all. The great fallacy on which we go in respect to the sea fisheries is the assertion that the fisheries are so naturally productive that nothing we can do will injure them; but that principle has caused enormous mischief, and locality after locality has been rendered fishless by it. Our forefathers, who made this great empire, and whose work we are incessantly engaged in pulling to pieces, knew something also of fisheries, and had minute regulations in respect to them. It might perhaps be urged that in some cases they were almost too minute. That might be, but it was at least an error on the right side. They set forth with a liberal hand the scale in respect to the length of every species of marketable fish, and below which no fish should be taken and brought to market. We have changed all this, and the result is disastrous. In most fresh-water fisheries, where it is desired to keep up a good stock of fish, laws are laid down, and rigidly enforced, as to the size of fish which are to be taken. In trout fisheries different sizes are laid down, according to the capacity of the stream, 2lb., 1lb., ¾lb., and ½lb. being the various weights set forth when weight is the criterion; but weight is an unsatisfactory test, for if the fish is pulled about, and kept out of the water until it can be weighed satisfactorily, it is bound to be more or less injured. To avoid this a system of guessing is acted upon, and under this it is not too much to say that the scale goes up a good fourth. No one can guess within ounces of the weight of a

fish, and over-estimation is sure to prevail. The best means, therefore, is to adopt the method of measurement, which is yet more common than weight, and any size, from 16in. to 6in., is adopted on various fisheries. It is a good plan to have an inch measure from 6in. to 14in. marked on your rod-butt or landing-handle; and if tackle makers would note this it would be very serviceable, and keepers should be compelled in every instance to see that the order is obeyed (see Appendix, 3). There is also a good rule on some waters as regards the number of fish to be taken, and where the water is only limited it is very desirable that some such rule should be observed. In some cases it is confined, on waters near London, where the limits are short and the fishing valuable, to a couple of brace; you have your sport, but, having taken your allowance, you must return all the rest. There *are* London anglers who in such cases never can catch more than a leash, and are always working away for that last fish. It behoves the person in charge of the water to keep an eye upon such individuals. In other places you go up to four, five, and six brace. I caught twenty-two brace in a noted water on the Kennet last season, sixteen brace of which I had to return, and many of them better fish than I had in my basket. I did not want to keep the fish myself, as I had plenty, but in this case they would have been far better out of the water, which was much overstocked.

In cases where the water is overstocked like this it is a very good plan to establish two or three good stews on the water, and when you take out a fish which is thin and in poor order to pop him into a carrier or kettle, and turn him into the stew, when a few weeks of feeding will put him into tip-top condition. You have always then fish for the house in your stew, and do not need, as is the case in three or four waters which I know, to set the keepers to use the net in order to supply the house, for that is a very risky practice, and throws a great temptation in the way of the keeper, which

really is not necessary. These fish in the stews, too, can always be made an important use of. You can keep them till spawning time, and either utilise the spawn from them for your own purposes or dispose of it to others in any way you think fit, and by supplying these fish with abundance of good food you can bring them into good condition unusually early. But I shall speak of this again.

Too great care cannot be exercised by keepers not to leave their weed scythes lying about in the grass near the river. I once had the narrowest shave of a terrible accident. I was walking in some high sedge, and struck my foot against something. Looking down I saw it was a scythe. As I was not hurt, I merely moved it, and condemned the gross carelessness of the keeper. When I got home, on taking off my brogues, I found that two thicknesses of hard leather, a strap, and a shield over the instep of thick pig skin, nearly half a inch thick, had been cut almost completely through, and, but for the most unusual chance of my having on brogues with a shield, I should have been cut to the bone, and every tendon and artery over the instep would have been severed; this in a lonely place four miles from home. I shudder whenever I think of it.

# CHAPTER IV.

## THE ENEMIES OF TROUT, AND HOW TO CIRCUMVENT THEM.

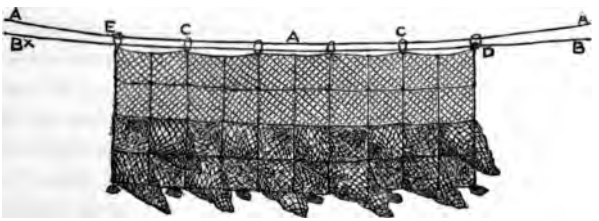
And now as to the enemies of trout. These are *chiefly* pike, birds, and poachers. I put pike first, because one 4lb. pike will do more mischief in a season than all the poachers in the district. Just consider, now, such a fish will, for about nine months in the year, want a trout every other day. They don't feed every day if they get a decent sized fish. That is about 130 to 140 to the year, or about as many, or more, as a first-class angler will kill in his season in a first-class club, for which he pays a 25*l.* subscription; so that your one pike literally costs you about 25*l.* a year (or what is worth that to you), to keep. I not long ago took four 6lb. pike out of the water of a club I belonged to. "Now, look here," I said to the proprietor, "do you know what those four fish have cost you to keep?" Of course he did not. "They cost you exactly as much as your whole club pay you, or about 300*l.* a year." He looked incredulous. "Well, now, look here again," I said. "How many fish did your club tottle up last year?" "About six or seven hundred, perhaps." "Just so; and those four pike would about eat that number, so they cost you 300*l.* a year to keep." He had never thought of it in that light; he was very glad that I took those pike out.

And now I may give a few directions as regards the destruction of pike. There are several ways: first, by the net; secondly, the spear; thirdly, the wire; and fourthly, the snatch; and fifthly, by shooting; and lastly, by trimmer. The best time to net, of course, is in the winter, when all the

weeds are down. If the water can be reduced at all, by running a mill down, or any other means, by all means reduce it, if you can, to four or five feet deep, as that is the best depth for an ordinary pike net, which should be a double-walled trammel, with square (not diamond) shaped walling, with a net between of about a 5in. or 6in. mesh all round, and plenty of lint or netting in it, so as to admit of a fish bagging himself in it. This net, which should be from fifteen to thirty yards wide—from twenty to twenty-five being a good medium—should run upon rings either of bone or horn freely, these being fixed on the cork line at intervals of 15in. or 18in.; through them the main line is rove, one end of the net is made fast to the main line, the other is loose, and on to the further or loose end is fixed a long light line, the ends of which are also held by the men on either side of the river. The end which is held by the man who has hold of the fast end of the net comes back to him rove through the rings along with the main top rope—for convenience we call this the gathering-line. When a pike strikes and is meshed, if it be thought desirable to take him out, the man on the further side lets go of his gathering-line, and the man on the fast side hauls rapidly on it, gathering all the rings (and, of course, all the net in folds) on his own side of the river, where it is hauled out in a mass, the fish taken out, the net reset, cleared, dropped in the river, and hauled across again by the opposite man, till it is once more fully extended. The cut appended shows these actions. The net should be heavily leaded to prevent rolling. (By the way, in my sketch of the net I find I have forgotten the corks, rather an important factor; the reader must give credit for them.)

When you are about to put the net in the water you pull the loose lint through the walling in pockets on the up-stream side (of course, you drag down-stream) every other square of the walling. When a fish strikes he rushes into one of these pockets, and in turning round usually comes back through

another, and in his struggles is hopelessly bagged, when you can either leave him and work on for another or two, or haul in the gathering-line, and take him out. The reader is supposed to be behind the net in the cut so as to show the pockets pulled through the walling. Now, there is this to be remembered in setting this net—a pike always strikes low, while a trout strikes high. If, therefore, you set your net (that is, pull the pockets through the walling) to catch pike, you must pull the lint through the walling near to the lead line. If you are for trout, you must do so higher up, nearer the cork line, or your fish won't bag. The net shown is set




A A A. Top, or main line.
Bˣ B. Gathering line hauled home from Bˣ.
C C. Sliding rings.
D. Net made fast to gathering line.
E. Ring made fast to main line.

for pike. If your net will not reach quite across the water, as it often will not on shallows, someone should beat with a pole in front of the net the vacant space, so as to drive any fish seeking to escape that way further in towards the middle of the net. If the bottom is fairly clean and the weeds cut close, this is a deadly net for pike, and will not miss many of them. You want no stop net set across, for pike in their first rush nearly always strike up-stream. But one thing you should always bear in mind, and that is to keep the net moving, never let it be still if you can help it, as that is the time when fish get away. Of course nets will hang up at times, and a man in a light boat should always drop down

behind the net with a long light pole for punting purpose with a hook at one end to lift the lead line with over any obstruction. The best time to net is, as I have said, in the winter, when the weeds are down, and always after a heavy flood; but if the water is much infested with pike, the process should be repeated every time the weeds are cut, and bear in mind that one pike caught before the spawning season in April or May is worth a dozen after. As the spawning season draws near—and it should be watched for with great care—the fish begin to get into drains or ditches, or rushy, flaggy eddies; it is always worth while to run the net round such places at that season, quietly to stake it down with a couple of ripecks (iron-shod poles), one at each end, and then to beat the flags out, or the ditches down, and to drive the fish out headlong into the nets. In lakes they either do this round the sedge beds, or they use large drag nets (seines), or they set long common trammel nets, and examine them night and morning. The seine is simply run out in a big semi-circle, and drawn home on the shore. The trammel is like the net I have described, only without the rings or closing up apparatus, and is extended out at right angles with the shore, and fixed by poles.

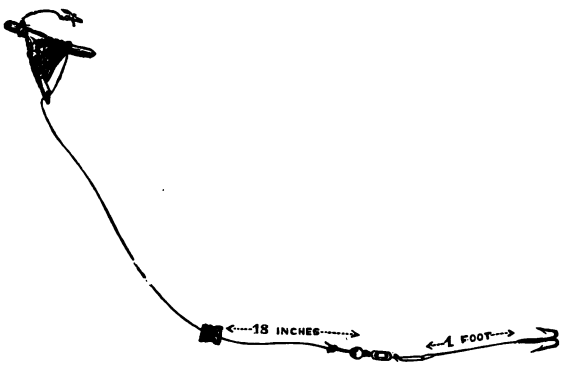
And now for the spear. The spear should be strong enough to hold down a 12lb. fish, and that wants a pretty strong one; a small grains, such as is used on board ship, answers very well, and a pole some sixteen feet long. When you see a pike basking, get as well over him as you can, put the iron as close down to him as you can get it without starting him, and then drive it home just behind the shoulders. Having hit him, pin him firmly down to the bottom, until he ceases to struggle, when you will not have so much difficulty in getting him out. There is a method of destroying them called snickering, which is chiefly used for eels. Fix a reaping hook on to a long pole, and, having sharpened up to the keenest, poke it slowly under the pike, when, with a sharp stroke, you can nearly cut him in two.

The wire does not require me to say much about it, and most people know how it should be employed. One thing I may mention, viz., that it is desirable that both the wire and the pole it is tied to, as well as the spear pole, should be painted green, so as to be less alarming to the fish; for, if you miss spearing or wiring a fish badly, he gets frightened, and it is not easy to get so good a chance at him a second time, as a pike will often shift his ground to some distance after a miss of this kind. Wiring requires a steady hand and great skill and caution. The wire should be of good soft pliable material, and slip easily. It should be passed over the nose of the fish with slow but steady motion, and when well over drawn tight about the gills; as the first impulse of a scared fish is to rush forward, when once gripped, he does not get loose easily. Our keeper, Lock, at Winchester, is one of the most skilful wirers I know. A lesson from him is invaluable. Snatching is done either by a pole and a gaff in the usual way, or by a big triangle fastened on to a stout line; this is run through a ring at the top of a strong bamboo, the end and some spare line being held in hand. If the operator spies a fish, all depends on how far off he is. If he is within the reach of the rod point, he simply drops the triangle softly just beyond the fish, draws the hooks close, and then jerks the hooks into his belly and holds on. If the fish is further off, he casts out beyond him, and very softly draws and humours the line till he gets the hooks conveniently adjacent on the far side of him, when he gives a big heave, and ruggs Mr. Pike severely. The keepers at Leintwardine used to be famous hands at this; and one year, when I was there, I think I heard that they took out some two or three hundred pike by this method.

And, lastly, as to shooting them. If a keeper knows his business, this is not difficult to a large extent. As you walk down the banks of a river in fine warm weather, you will constantly see pike start off from the shallow sides where

they are basking. Take, then, exact note of those spots, and when you come down the river with your gun, approach them very softly and quietly, so as not to disturb the fish, and you will often make him out basking only a few inches below the surface. Then let him have it about the head, and a little this side of him, to allow for deflection. If the fish lies in somewhat deeper water, a pea rifle with a conical bullet will often do it.

Trimmers are a first-rate auxiliary if the spot be suitable, and often available when no other methods are so. The best trimmer I ever saw for this kind of work was




taken from a poacher at Henley, a London angler (exteriorly a gentleman). It was of fine water cord, the sinker used was a cube of Macadam granite an inch square. 18 inches beyond this was a rough brass swivel, and to that was fixed a long loop. The hook was the usual double one on wire (annealed). The bait being carefully threaded, was attached to the loop with about a dozen or twenty yards of the water cord twisted to and fro over a forked stick. A nick or split in one of the forks held the line till it was jerked out by pikey. The end was tied to a bough or a springy stick stuck in the bank, and the bait was then pitched in; the stone kept the bait in place, but was not heavy enough to check the pike in his run.

The bait, having some eighteen inches or two feet law, struggled upwards as all baits do, and was therefore in full view when the pike seized it; if he wanted to go to any lair hard by to gorge, the slightest pluck released the line from the split, and there was some twelve or fifteen yards to unwind off the forked winder, and before this was exhausted he would nearly always have swallowed the bait, when he might do what he pleased. A nice dace of some four or five inches long (according to the size of the pike) is the best bait for this purpose. Trimmers should be set in the evening, and looked at early in the morning.

Some people think that a few pike in a trout stream do not do any harm, but serve to keep down the fry and to promote the size of the trout. This is utter folly. Is one pike worth 150 trout? that is the question; and even suppose they are only 150 stores of three to the pound, which is far below the mark, that 150 stores are worth 150 shillings, and I have yet to see the pike which is worth 7*l.* 10*s.*, living or dead. No: what you want is someone on the water, either the master or the keeper, or a well qualified friend, to tell you when your water is in order or over stocked, and what to do then. A farmer always knows how many sheep such and such a field will carry. And if you have too many fish in it, just advertise that you want to part with them, and you will get a good price for them when you net them out; and if you do not know, and your keeper does not know either, when the river is properly stocked or otherwise, why, send for me, and I will inspect and report on your stream. Good store fish are wanted now all over the country; so many streams have been over fished, over piked, over poached, or neglected, and so many new waters, ponds, and streams are being stocked. One word on other coarse fish, as dace, chub, &c.—out with them wholesale—net, net, net! No fair trout stream can afford to keep roach, dace, and chub. Everyone eats the food of a trout. Net them out, and make them a present to

the poor of the district, who will relish them highly, and be thankful for them.

And now as to poachers. A good keeper is a good thing, and if he has a sharp dog, not too big, though, but who knows when to bark and when to hold his tongue, and who will even go in at a poacher and worry his trousers, if need be, he is a better. On a darkish night a dog will detect poachers when a keeper on his rounds could not. A bad keeper is about the worst thing that can happen to a water; none at all is infinitely preferable. A bad keeper may be bad from being only a fool, though a fool is very often a knave as well; or he may be careless, and prefer his bed to that of the river; or he may be partial to beer and tobacco, and fond of the public-house; and he may be an out-and-out drunken beast and idiot, who is at the mercy of every poacher who will stand him drinks; or he may be a perfected and sublimated scoundrel. There are a variety of badnesses. A good keeper should see as little of the public-house as need be. I do not say he never should go into one, or never have a pint of beer in one, though I did know a friend once who allowed his keepers a nine-gallon cask of beer once a fortnight in their own houses, and sacked them ruthlessly if he ever knew of their being in a public-house. A sharp keeper, who has his wits about him, can pick up a good deal at the pub. A peep into the tap of an evening will often tell him a good deal, and a pint of beer in good fellowship will make him popular, but *he should never sit down for a booze.* But an out-and-out bad keeper is a scoundrel of the worst type. He is ten times worse than the poacher himself; for he has a living assured him if he does his duty only tolerably; of course, the better he does his duty, the better that living will be sure to be, so there is no possible excuse for him. A rascal of this sort always has fifty thousand excuses cut and dried. If the poachers have had a success on the water below, "he had but a just left that werry water, and was gone up above;" and if

above, "It were most unkimmon strange how they could, for he hadn't long left there for the water below." If they sweep the shallow, and you show him half a dozen places where the net has visibly been landed, with all the refuse, weeds, small fry, footmarks, &c.—"Well, that be wonderful; whenever could they a done it? It must a bin when he thort he'd a heer'd or seed someun up on the deep water," and he grins quietly at your credulity as he feels the two or three half-crowns in his pocket, the proceeds of his share in the night's robbery. Then he cuts the weeds close on the shallows, where they can be netted easily, and leaves them long in the deeps, where they can't, in order to be able to say that there are plenty of weeds *in the river*. If you tell him to stake a shallow, he puts all the stakes where they are not wanted, and takes good care to put none at all where they are. He notes well where the best fish lie, and shuts the hatch down so as to draw all the fish up, and not to have too heavy a stream for the net. In fact, his devices to serve his friends the poachers, and to get from them the price of gallons of beer, are endless. Ostensibly he is the most civil, blarneying, carneying blackguard going, and butter won't melt in his mouth; and, oddly enough, there is not a man whom he meets when with you in the fields, but will "like to drink your honour's health. He puts them on to cadge on you, and stands in. I have, unfortunately, seen such keepers as this, though, thanks be, they are rare; and it is rather surprising that keepers, as a class, are as good as they are, as they are seldom overpaid for the duties they perform.

Now, as a rule, a keeper need trouble his head but little on deep or heavy or very weedy water. Poachers cannot work their nets there; for the nets they use are light and handy nets, which can be worked quickly and carried easily and without notice. Such nets are quite useless in heavy water. If there be any suspicion of night-lines as the keeper walks down the bank, he may run a stick with a hook along the

edge, when he will catch them if there are any. But if he is to watch to any effect any part of the water, it is the gentle, purling, dimpling, gravelly shallows about 2ft. or 3ft. deep, up to which the fish draw to feed nightly, that need his care. But a stake or two judiciously driven in a shallow, and properly dressed with tenter hooks, will save him a great deal of trouble. Stakes, to be effective, should be about 2½ft. long, and about 3in. in diameter, cut out of some hard wood, and well pointed, about 6in. of the upper end being garnished all round with tenter hooks, closely driven. Some tenter hooks should be set with the points down and some points up, to catch the net both ways, whether raised or dropped. To drive these stakes you want a heavy mallet and a driver with a shoe. This should be a short, round spar of oak, about 2ft. long, or more, as the case requires, and about 4in. in diameter. At one end of this is an iron ring, clamped to prevent splitting; and at the other an iron shoe or socket, to fit over the head of the stake, and prevent it from slipping. Pop this socket over the head of the stake, put the point of the stake to the gravel, and then mallet the driver on the other end till you drive your stake some 15in. or 20in. into the soil. That will leave some 10in. or so of it above the gravel, with all the tenter hooks; and if a net takes it, it will be a case of tear, and, in dislodging it, every trout will be scared off the shallow. You don't want many stakes on a shallow, unless it is a very large one; half a dozen or so will do your business very effectively, and they are always there, while the keeper cannot be. But the keeper should have his eye on them, and take care not to let them get too clogged up with weeds. Tin cuttings, or bits of old wire window blind, or old wire netting dispersed about on the bottom over a shallow, take up very little room, and are capital poacher-puzzles, as they hang a net up in heaps, and take endless time to get out, as the wire must be broken into minute fragments to disengage it, and a net well tied up with old

wire window blind can hardly be used again that night. Alarm guns are by no means bad auxiliaries. They can be easily set anywhere of an evening, and, if not discharged, taken up again by daylight. Half a dozen of them take little time to set, and the noise they make sends the poachers flying. They cost very little, and are easily set; but they must be put where animals cannot knock up against the wire.

As to the question of swans, ducks, geese, and other aquatic birds, I have heard it stated that this, that, or the other bird does not harm the fish. Don't believe it; for there is not an aquatic bird that swims which will not devour spawn and fry of fish, though ducks and swans are the worst offenders. The persistent way in which ducks will, day after day, work a shallow where the trout have spawned and the alevins are wriggling in the gravel; how they will come from two miles distance to indulge their mischievous propensity; and how it is almost impossible to drive them away, must be seen and experienced to be believed. Swans are quite as bad, or worse, because their capacity is much larger, and the length of their necks enables them to reach greater depths of water. No one who values his fishery one straw should ever allow either upon his river. The injury a flock of ducks can and will do in the month of April is enormous and unsuspected. It is upon the very places where all the best trout spawn that ducks can and do work (see Appendix, 4). The injury which they do when eel fare is coming up the river, in the destruction of thousands of small eels, is fully recognised in some places. I remember once, when salmon fishing in early June at Ballyshannon, seeing a couple of ducks very busy near the cribs. Presently I heard "Bang, bang!" from a double gun hard by behind me. I also heard a faint "Quack!" and, looking round, I saw the two eel-devourers floating on their backs, one of the bailiffs having taken summary proceedings. I certainly, after warning the proprietors of such *voleurs* to keep their ducks

away from my spawning beds, should give them to understand that, if they did not, I should shoot them. To have all your stock of spawn for the year devoured by ducks is too much of a good thing. All other aquatic birds are more or less offenders in this respect. Some time ago I remember a plea was put in for the pretty little water ousel in the *Field*—he was perfectly harmless, and only ate beetles and insects. A few months after this, however, I was at Inversnaid, and there were a pair of water ousels, with a nest of young ones, behind a waterfall. One of the birds, while I was looking on, was out hunting for provant, and, after being very busy under water for a space, he suddenly popped up his head with a small fish of minnow size in his beak, with which he scuttled off to his nest.

I do not in the least counsel the destruction of all the pretty feathered denizens of the stream, which often give such life and charm to solitary waters—far from it. I merely wish to dispel an illusion that they are perfectly harmless to the fish, and desire to suggest that you should keep an eye on them, and not let them increase too much. Gulls and terns are most notorious and terrible offenders where they are much encouraged, and the injury they often do on salmon rivers is untold when the smolts are going down. A couple of hundred gulls will devour *at least* a thousand smolts per diem. I have seen them at Loch Lomond travelling to and fro from Gull Island to the burns all day long, and each with a parr or a small trout in his beak. No fishery in the world could support this kind of thing to any large extent. I am quite sure that the fishery at Loch Lomond is heavily injured by these marauders, and I have seen hundreds of gulls at smolt time eating up the future stock of grilse in the Tweed, above Carham. If a person prefers gulls to fish, there is nothing to be said; but, beyond all, I do counsel all proprietors of trout streams not to allow either ducks or swans on their streams from February to May. On the Test (the Houghton

fishery) they do not allow you to wade on the shallows till the 1st of May, because you would probably trample on the trout hills, and destroy much spawn; and I think it is a wise regulation in more points than one.

One of the most troublesome pests to a fishery is the heron. Few people know the mischief which one or two of these birds are capable of doing. They have an insatiable swallow, and can spike and bolt fish of up to a pound weight or over. I have often picked up pound roach with a hole through their backs, where they have been speared by Mr. Jack Heron and dropped in some sudden alarm. They are so wary, too, that it is difficult to get a good chance at them with a gun, and you must hide long before light, and very carefully, to get it. At earliest daybreak is the best time to look out for them. A rifle bullet close about their ears, even if it fails to touch their skins, will give them a sharp notice to quit if repeated once or twice. Walton's method of fishing for them with a bait *à la* trimmer, set in the spot where they are seen to fish, is no bad plan. It should be fastened to a cudgel, as he advises, just so big that, though they may drag it along, they cannot fly away with it. A pair of herons will clear out any short stretch of water, if unmolested for two or three weeks.

Kingfishers, too, want very sharp attention, particularly near nurseries where fry are. They will collect on such places from far and near, literally in dozens, and the way they will clear out a nursery must be experienced to be believed.

There is another question in the regulation of waters, and that is the removal of the big old trout. In first-class south country waters the fish to rely on for the best sport are those from 1½lb. to 3lb. When fish get to 4lb. and upwards they are no advantage to a river; they live largely on their own great grandchildren, and occupy the best places in the river, to the entire exclusion of other fish—a snug hatch-hole, for

example, where a dozen good fish would lie, and give sport, too, all the year round, will be rendered useless to the fishery by reason of the presence of one or two old soldiers who won't rise at fly at all. My course always would be with these old rascals to get them out by hook or crook; and, if they won't take fly, then have them by worm or minnow, or any other way you can. They are, as regards the small fry, worse than pike. Some people, however, like a big 4lb. or 5lb. specimen fish or two to show friends, and aggravate them into fishing for them in some cramped place where, if you do hook your fish, you can't kill him. I like my friends to have sport when I do ask them, and am not blessed with that sardonic humour which delights in their discomfiture. A 2½lb. fish is the size which, as a rule, gives the best and most striking play; he runs, jumps, and plays up Old Rose; whereas your four or five pounder, with *moderate* fly tackle, walks straight ahead deep in the water, and plunges into something, out of which you cannot haul him. I have killed plenty of four, five, and six-pounders in my time; but only one or two with small fly tackle. Most of the best have been on the more reliable Mayfly or the large sedge, with which at eve you can use reliable gut.

On otters there is not much to be said; they are, for the most part, more destructive of pike and eels than trout. But if an otter should frequent your trout stream, you will soon know it; and if you cannot contrive to shoot him, you must trap him. You will easily trace his seal or footprints on sand or mud; and on grassy banks you will usually find his landing places without difficulty, as the grass is brown and withered in patches from certain causes. Here a trap should be set, strongly chained and pegged down to the bottom, and set under water, not on the bank; and see that the trap has holding teeth, for an otter has been known to bite his own foot off when caught in a trap; but usually he gets into the water, and the weight of the trap drowns him.

# CHAPTER V.

## THE ARTIFICIAL INCUBATION OF OVA.

And now we come to the subject of the artificial incubation and hatching of fish. There can be no doubt at all that in the natural state there is a vast waste of ova and fry, and in order to make up for this necessary waste, fish have been endowed by nature with an enormous power of reproduction; and, indeed, if only a tenth or probably even a hundredth of the ova which a fish contains were to come to maturity, our waters would be greatly over-stocked; but, in the first place, a good deal of waste takes place at spawning time (let us take salmon or trout as a instance; the other fishes have fully as much or more waste attendant on them, though in other ways). Predacious fish wait behind the spawners, and pick up a portion of the ova as it drifts by. A good deal of it also is never fecundated, and this lies at the bottom of the river and rots, or is eaten up by the thousand and one destroyers of ova; for there is not a living creature which inhabits the water which does not prey more or less upon fish ova, and particularly trout ova, for trout will force their way up into the very shallowest little becks, where their backs are almost above water, to spawn. I remember when quite a lad being out snipe shooting in Cornwall. In the midst of the moor I was shooting was a wee brook, not two feet wide, and here not three inches deep, but which in its lower reaches half a mile below held trout, as all the little becks in that county do if there are no mines contiguous. A water rail got

up out of the brook, and I shot it; and hearing something splashing in the brook just at the same spot, I shot on suspicion, and coming to the place found I had shot three trout, which weighed a pound between them, and very fine fish they were for the stream. They had pushed up to spawn, and I expect Mr. Rail was feeding on the spawn, though it did not occur to me at the time. Kingfishers, as I have said, are dreadful trout fry destroyers; they will haunt and hunt a trout nursery with a persistence which is astonishing, and it is always necessary to cover your nursery closely with finest wire net, or they will find every fry out of it. I have heard of as many as eighty kingfishers being killed in one season on some famous nursery in the midlands. They must have flocked there from miles round. As regards the insect pests, the larvæ of beetles, dragon-flies, and even of the Mayfly, will do great injury, and not only to the spawn, but even to the young fry and alevins. Fortunately, one can thoroughly protect the spawn by the artificial process, and from all save insect pests one can protect the fry.

And now we must come to the process. I am not writing a work upon merely pisciculture, and therefore shall adopt the simplest and easiest modes of carrying out the work. The first thing to be considered is your water supply; and this should be as pure and clear as you can get it. If it is taken from a house supply, already duly filtered and conveyed in pipes, it will not need filtering again, but it should fall into a shallow tray to expose it to the air, and thence be conveyed to the hatching trays. If, however, you have to take it from a river or brook, it is desirable to have one that is as little and as seldom discoloured as possible, or you will find heavy sediment settling over the ova, which is very troublesome and injurious. Get it from as near the spring head as you can, convey it by pipe to your hatching place, let it fall into one end of a large open tray or cistern, and thence, by means of a stop-cock to regulate the supply, into a large coarse filter

of fine gravel, sand, or charcoal. And be careful about this, for until the supply runs quite clear it is not safe to use it for the hatching trays.

Now, these hatching trays should be either of slate, pottery ware or wood; if of the latter, they should be charred before every season with a hot iron inside, to check confervoid growth. These trays should be of a handy size, some six or eight inches wide, two feet to two and a half feet long, and four inches deep on the inside. These are merely approximate measures. The amateur will be guided by the sizes kept in stock by the pisciculturist to whom he applies for his machinery, Such a tray as that noted will hold two or three thousand ova comfortably. Now the ova can be placed upon a bed of gravel, upon glass grilles, or bars arranged closely together to prevent the ova slipping between them, on perforated zinc, or they may be laid on the bare floor of the trays themselves. The glass grilles, perhaps, keep the eggs cleanest, and prevent their moving. The supply of water, too, is given off as variously. Some run or drip it in from a tap, and some have tubes along the bottom or the sides, which are perforated, and send fifty tiny jets of water amongst the eggs. The fish-hatcher can employ any way which is most convenient. But if gravel be used it must be boiled first to destroy all animal life, lest there should be any insect larvæ prejudicial to the spawn. The gravel should be not larger than very small peas. A flat bed of this being prepared, the ova should be thickly distributed on it, but not so that one ova should lie or rest upon another; and a stream of water should be permitted to flow over it, about from one and a half to two inches in depth. The water will be poured into the tray from a small spout at one end, and should not be of larger volume than the size of a common clay pipe; that will be enough to work four or five trays. If the temperature of the air and water should rise much, so as to be dangerous to the ova or fry, the supply may be a little increased; but it

must never be so great as to wash the ova about; and, to prevent any disturbance, it is always as well to fence off the part where the stream falls in with a strip of perforated zinc; and, to prevent the ova entering the draught of the outlet pipe at the other end of the tray, the same precaution should be taken there. The second tray should be placed beside the

first, but an inch or two below it, just enough for the tray to clear the lip, or outlet pipe; and the same arrangement and precaution must be taken with this and every successive tray. It is not desirable to put more than four or five trays in a range. A cut of a range of trays in action is appended, and any number of ranges may be employed; but I do not care to have more than five or six trays in each range. Now, instead

of gravel, many prefer the glass grilles, as I have said; and there is this advantage in them, they are cleaner, and it is said that they give a better aggregate result, and prevent deformities which are common on gravel. There is one thing certainly which they avoid: the alevins, as the newly-hatched fry are called, when first hatched are very sensitive to the light, and are apt to burrow under the gravel, where they sometimes die; and if one or two die and you do not detect them, they rot and poison the others. I formerly had a considerable number perish in this way. With the grilles they cannot do this, but as soon as they are hatched they slip between the grilles to the bottom of the tray, and when all are hatched you simply remove the grilles, which are fixed on a light wooden frame, resting upon projecting knobs in the tray about half-way to the bottom. With these you can use the perforated pipes below. Some peeple use perforated zinc trays with a somewhat similar object, and some, as I have said, use only the bottom of the tray. There are endless methods of depositing ova.

We will suppose that your range of trays, whether with gravel beds or grilles, are now all in order, and the stream flowing freely and gently over them. You then have to procure your ova; of course, if you get it from some of the many pisciculturists who now supply it, and fairly cheaply too, you have nothing to do but to take it out of the case it is sent in, and to distribute it in your trays. But if you have to take it, you must net the river or brook, or wherever your store fish may be, and, having procured enough for your present need in large tubs, you take a shallow pan or tin, put about one inch or less of water in it—the less you use the better—pick out your female fish, and express the spawn as shown in either of the two following engravings. If the fish be quite ripe, the spawn will be loose and detached, and will fall towards the vent, as in the first figure on the next page, where the fish is held up. Then press the thumb and forefinger

softly on either side, and pass them from near the gills to the vent; and if the fish be ripe, the spawn will flow out in a stream of pellets of a fresh roseate hue.* If it does not do so, lay the fish aside, as no force must be used; for if the spawn is forced out before it is quite ripe, you kill the fish, and get spawn that is worthless. Sometimes a fish will retain its spawn; try the fish gently again after five or ten minutes, and if it does not flow freely then, return her uninjured to the

water at once. Having covered the bottom of the tray with ova about two layers or so deep, pick out your male fish and express the milt of the male all over the surface of the water

* A rather hypercritical friend lately complained that the fish held up in the cut above for spawning was held up too high above the water, but it was necessary to show it so in order to give a clear sketch of how the fish should be held and manipulated. The next engraving shows clearly enough that it *is* desirable to keep the vent of the fish pretty close down to the water. If the trout is a big one you may require the assistance of another person to hold his tail.

in this pan. This also should exude freely, and when you have enough for your purpose gently stir the water with the hand, so as to allow the milt to mix thoroughly all through the ova, and then stand the pan aside for a few minutes to allow fecundation safely to take place. Then keep pouring in fresh water, and pouring out the foul until all is quite clear and bright; then place your ova in a can three-parts full of water, with slings attached to it, so that it may be hung over a stick or on a hook in case of a long carriage or railway journey, so as to avoid jolting as much as possible; much shaking being always more or less prejudicial, as, in its

natural state, the ova is not accustomed to it. There is one thing, however, that must be carefully attended to, and that is, not to express the spawn of the female till you are quite sure you have the milt of the male handy for immediate mixture, as all the while the ova is in the water it is absorbing water, the shell being porous; and if it is left too long in the water before the milt is mixed with it, it seriously jeopardises the chance of proper fecundation. Indeed, many persons now use no water, but fecundate by the Russian or dry method, which gives better results, as it is stated: you catch the ova in a dry vessel and put the milt to it the instant you put it

into water, so that no previous absorption of water occurs, or you use very little water at all, just enough for the ova to slide on turning the pan from side to side to let the milt come in contact with the ova. I prefer the first plan, and think it more natural. *The great thing to avoid is any long immersion of the ova before the milt is applied.* The power of absorption of the egg is said to be limited, and therefore it is desirable not to lose time. The milt retains its vitality even for days if kept from air and light. Cork it in a bottle, and you may convey it long distances—a very useful quality when you want to cross breeds—as you can carry your milt to any reasonable distance from one river to fecundate spawn in another, if the fish happen to be spawning at the same time, which is not always the case.

If you are bent on taking spawn, pick out a mild day, as the fish come up better then. Livingstone Stone, the author of "Domesticated Trout," &c., recommends a soft rainy day, and says a cold, frosty night is bad, as is a raw chilly day, and he has this: "Francis, I think, says that a cloudy day is best for spawning. My experience has been entirely to the contrary, unless it rained. The explanation may possibly be that he saw them best on a cloudy day, as they are less shy on such days." Now, if I am "Francis," all I can say is, that I never said anything of the sort, and that people should not "think" when they attempt to quote others, but should be "sure." As regards my capacity for seeing trout: if the day was very cloudy, indeed, and it had been very wet with "the dew off Ben Nevis," I might see double as many trout as I wanted to; but I have given up all such vanities long ago, and I can see trout in the water as well as most people; and I should not be surprised if I have in my time seen quite as many as ever L. S. did. So much for the ova of trout and salmon.

Before going on to the regular treatment of ova, I may say a few words on that of grayling. Grayling come on the spawn and get it over very rapidly, so that, if you do not

watch very carefully the river where they are, you may (as I have, more than once) come and find it all over. When you express the spawn first it is small, not bigger than No. 7 or 8 shot; but after it has been fecundated for a short time it developes another sort of false skin, which swells the ova out to nearly the same size as that of trout. Grayling ova takes a much shorter period, too, to incubate than trout, being hatched in about a fortnight as a rule. But care must be taken to keep the temperature of the water down, and not to let it get above 47° or 48° at the highest, as the weather begins to get warm often in April, and byssus (or fungoid) developes then with great celerity, and spreads in a terrible way. The fry, though small, are pretty hardy, however.

Having got your ova to the trays, pick out the dead ones, which you will detect at once by their being more or less white and opaque, and distribute the others, either by means of a spoon or a cup as may be convenient; and, having placed them in close proximity and level surface in your trays, you have nothing to do but to pick out any dead ones daily, and to leave the others as still as possible until they hatch. To pick out the dead various instruments are employed. Some use tubes working by suction; some tweezers of scissor shape, with round hollows like old sugar tongs to hold the egg. I used always to employ an old cork or quill float with its round wire ring at the bottom turned sideways thus: With this I could pick out the bad ones as quickly as need be. A bit of stick and a bit of fine brass wire does as well, of course. The dead ova must be removed daily, or it affects the rest. When dead ova is left in the tray many days, it begins to develope byssus, or a fungoid sporous growth akin to that seen in *Saprolegnia*. As soon as this touches the next egg, that is liable to be attacked too, and thus, particularly if the temperature of the water be at all high, this affection spreads with extreme rapidity. I have had to

throw away whole trayfuls of ova which had become so attacked, and once lost nearly 100,000 grayling ova by this means. The weather grew warm (it was nearly May), the water ran up in a few days from 46° to 54° and even higher; "byssus," as the growth was then called, set in, and nothing I could do would stop it, and I lost my whole stock. I had, unfortunately, no means of employing ice largely, as I would always do in future, particularly with grayling ova, which comes in so much later than trout that hot weather is always possible.

If any sediment settles on the eggs, you can very softly brush it off with a camel's hair brush; but you may kill some of the eggs by doing so; and, on the other hand, you may lose a lot by the sediment; so you must use your own judgment. When a salmon or trout egg is in perfection, it is not quite clear, but there is a dim sort of yolk in the centre —a sort of dim disc within a disc. If the egg is quite clear, it is probably unfecundated, and though for a long time it may look nice and bright and of good colour, it won't come to anything, but decays sooner or later. According to the temperature of the water, so sooner or later the embryo within begins to develope, and at any time, from thirty to fifty or sixty days for trout, or longer for salmon, the ova begins to quicken. First you see a small dark speck, and when you take the egg out in a glass tube or syphon, which is used for that purpose, you see that this dark speck is the eye of the embryo, and you will see a streak round the interior of the egg, which is the future vertebrate column of the young fish. Day by day the appearance of the young fish within becomes more distinct, it moves about in the egg, and in time even the veins and the circulation may be seen. From a fortnight to a month after the eyes appear the egg hatches; the shell bursts, and a slimy-looking wriggling globule forces itself out into life. On what becomes in time the belly of the fish is fixed a huge sac,

nearly as big as the original egg, within which is a glutinous matter, by the absorption of which the alevin, as it is then called, subsists for the next month or six weeks. Remove the refuse eggshells as best you can, and leave the alevin in perfect quiet. At this time the creature is peculiarly sensitive to light, as I have said, the eyes not being fitted to receive it, and it is necessary to shade the trays altogether with a board or a covering of blue or brown calico.

# CHAPTER VI.

## ON THE REARING OF FRY, AND THE CONDUCT OF PONDS, STEWS, ETC.

After the hatching of the ova, all you need to do is to remove any dead alevins. The living ones grow rapidly. Day by day the umbilical sac becomes absorbed, and grows smaller and smaller until, at the end of four or five weeks, the creature becomes a perfect little fish, in full possession and use of fins, tail, eyes, and even digestive organs, and it roams about in search of food, and darts at every little substance which may seem to afford it. When this time arrives, the shade may be removed and the fish requires much more space and water. They are then perfect fry, and should be changed to a much larger tray with more and deeper water. They may be fed lightly with biscuit dust and boiled liver grated, and forced through a fine sieve; but this must not be over done, and no refuse must be allowed to accumulate on the floor of the tray, or it putrifies and becomes offensive. From this time food and pure water are the only necessaries to attend to. When the fish grows large enough to be affected with the disease called gill fever, which often destroys large numbers, they should be removed into larger and deeper water; confinement and crowding is too often the cause of gill fever, and you want depth of water as well as space. Sir Jas. Maitland says that four feet depth is the great cure and prevention of gill fever. He puts his fry into reservoirs of that capacity, and they never have it. Gill fever is an inflammatory affection which attacks the young fish; what it arises from we do not quite know; from the way it runs

through a tray from fish to fish it has been deemed by some an affection of a typhoid character. I, however, think that it is something more like inflammation of the lungs or gills, as changes of water and varied temperatures are very apt to produce it, or some other fatal attack very like it. The fish attacked develope a small red spot on the thorax, swim about uneasily with their mouths open, gasping, and die gapeing. When the fry are hatched, in many cases monstrosities are produced—fish with two heads, or two tails, or even two distinct bodies joined like the Siamese twins; but they never grow to any size, mostly dying in infancy. Sir Jas. Maitland says these are much commoner on gravel than on grille hatched fish; and, though it may seem strange, I have heard others whose experience confirmed the statement. Certainly I have seldom seen any from his ova.

When your fry are fit to turn into the nursery, which, as I have said, should be covered closely with wire net to keep birds out, you must take care that the nursery is thoroughly cleared of all other fish. No fish of any kind but those you put in should be allowed. I once knew 1500 beautiful Loch Leven fish eaten up by a score of bull-heads or "Tommy-cods," as they are called in that part of the country; the fry vanished, and the keeper could not think what had become of them, for "there wa'ant nothin' but a score or so a' Tommy-cod in the place." Paraphrasing the celebrated crumpet story in Pickwick: "That's it," said I. "Wots it?" says he. "Tommy-cods," says I. "Tommy-cods is wholesome," says he. "Tommy-cods is not wholesome," says I. "How many Tommy-cods 'd be able to eat that lot?" says he; "Would twelve do it?" "They might," says I. "Fifteen 'd be sure to?" "Sartain," says I. So he gets twenty, and goes home, and don't blow his brains out, as he had not any to blow, in defence of his principle that Tommy-cods was wholesome. But they eat the fish, for a bull-head is a voracious beast, and as bad as a kingfisher or two any day.

Having seen your nursery cleaned out—the bottom of which should not all be of uniform depth, but a little uneven—distribute bits of slate or tile, tilted on one end, or small stones, to form refuges for the fish. The stream at each end should flow through perforated zinc. The intake should have a grating fixed to catch all weeds and rubbish. The zinc should be in a panel, and this should let in to a groove or a slide; and two or three of these panels should be provided, so that when one gets foul and dirty it can be pulled out to clean, and another thrust into its place instantly.

The stream through the nursery must not be too strong, or the weakly fry get driven against the lower barrier and perish. It is as well, if you want fry to thrive, to vary the food as much as possible. Chopped worms, blood-worms, boiled liver, biscuit dust, fish roe, as that of plaice, &c. (this sparingly, as they are apt to gorge on it)—all these may be used in turn. A few gammari, or fresh-water shrimp, may be kept in the nursery as scavengers, to clear up any refuse food. When the fish get bigger, chopped mussels and flesh of all kinds are very improving pabulum, and the fish thrive on it; and so you go on until your fish are fit to turn out. Now comes the question as to what is the best age to turn out. The longer you keep them in confinement the more your stock will diminish, for the big ones *will* eat the little ones occasionally; and the more the trouble and cost. I was holding a consultation with Sir James Maitland lately on this very point, and he entirely confirmed my own view as to big-minnow size being the best size to turn out. If you keep them too long—say till they are six or eight inches in length—they never take properly to the water they are put into; they become a sort of overgrown hobbledehoy, like boys that have been kept at home too long and tied to their mother's apron strings; when they do get loose they are sure to come to grief; they have so long been accustomed to be fed, that the notion of seeking food and foraging for themselves is quite

new to them. As for running to shelter in a danger, they have no idea of it. The first flood finds them all abroad they get into the strongest of the stream, and get carried down out of your waters miles below. I have seen this often. On the Thames they kept the fish till they were six or eight inches long, and as often as not these fish, put in at Sunbury and higher up, were taken in the nets at Kew and Mortlake. But put them in big-minnow size, on a light shallow, and you get them in some weeks before there are any floods, and when the trout are mostly on fly food; and by the time danger comes to them they know all about it, and can take care of themselves. I have seen this plan also succeed admirably. It is advisable when you turn them in to scatter fragments of drain pipes, &c., about over the shallow to form refuges and protection for the young fish; as they grow in stature and strength, they will drop off these into deeper and stronger water.

There are one or two points in connection with the carriage of ova and fry which I want to touch on. Ova can be transmitted a considerable distance with care when first taken, but when once laid down for a day or two it is not advisable to disturb it again until the eye is developed in the egg, when it will again travel long distances safely. It should be packed between layers of wet moss, not too tightly pressed, and packed in some case which is not liable to injury. There are many other ways of packing ova if you want to send it to the other side of the world, but I do not touch on them. This is a rough-and-ready plan open to all. In this way it will travel for several days without harm, and with very little loss.

In conveying fry, there are few things better than a carboy. There are some enveloped in wicker baskets which do splendidly. They should be filled up to the neck with water, a bit of muslin, with pin holes in it to admit air, being tied over the top. In this a large number of fry may be conveyed from

one end of the country to the other, with hardly any loss, very little change of water, provided there are no long rests on the journey. The constant shake of the train, &c., is serviceable to the contents, by aerating the water more or less; but too long a stillness is bad for them. But there is this to be borne in mind, viz., that when you want to send fish of any size on a long journey in this way, you must prepare them for it by reducing their food, and finally by starving them for some days. One of the most fatal causes of loss in such journeys with full-fed fish is the choking caused by the shaking up of the accumulated fæces, which gets into the gills of the fish, and soon chokes them; and a few dead fish in a can soon make more. Of course, if carboys cannot be had, large cans of tin or zinc, like oil cans, with small necks to prevent spilling of water, can easily be used in their stead. These should be made of zinc, not tin, which rusts.

If larger fish than fry are sought to be carried, larger vessels must be employed, up to twenty or thirty gallons even, or more. In such cases it is well to place the fish in iced water if the journey is to be a long one, as it will be a long time before the temperature of the water can be seriously affected; but care should be exercised to see that the temperature of the water into which the fish are to be changed is not *very* different from that which they came out of, or it will be productive of a good deal of mortality in the fish. These recommendations are given in the Howietoun circulars; and, moreover, two other things are stated—one, that it is unsafe to send fish of any size above fry on long journeys, save in the winter months, and that it is desirable that, at whatever railway station they may be delivered, a cart to convey the fish should in readiness, so that no time should be lost. Of course, it is always towards the end of a long journey that danger and loss are to be expected, and ten minutes of risk then is more important than an hour at the

commencement. Some fish are very hard to kill, some die easily and quickly, and I fear that most of the salmonoids are among the latter number. The grayling, for example, is very easily killed, and I have more than once seen a half-pound grayling float away dead when only cast lightly into the water, instead of being carefully put in. The concussion kills them directly. Trout are harder to kill, but there are many fish which will live where trout would die instantly. I have, for example, seen a gudgeon live in a cesspool, where a trout would not have lived one minute. It is a common dodge, where paper mills or other destructive works have killed every trout in the stream for miles, for witnesses swear that the mixture was innocuous to fish, because they have seen gudgeou, and possibly dace, &c., alive in it. But what is one man's meat is another man's poison, says the proverb, and so it certainly is with fish, and it is worth bearing this in mind.

Now all this is in reference to the artificial style of "rearing" your fry; but I must not neglect to point out that there is another and perhaps more natural and profitable method. This which I have dealt with so far is the method to pursue when you have only limited accommodation, and must bring up your fry artificially, which is the plan adopted by Sir Jas. Maitland and many other pisciculturists, who conduct large operations in limited areas. But if you can adopt the methods pursued by Mr. Andrews, of Guildford, which is the more natural plan, no doubt it saves trouble and expense. Mr. Andrews, however, is exceptionally situated. Owing partly to the conformation of the ground, and partly to other circumstances, there are a great number of ponds round about Guildford, within half a dozen or a dozen miles, and these are often, in sets of two, three, four, or even more, communicating with each other, and are fed by small streams, which are very abundant in the little valleys that break up the surface so universally throughout the county of Surrey. In many instances small gulleys occur, where, by throwing a

small dam or two across, these streams are arrested, and made into ponds of from one to more acres in extent. These ponds (some of them) were devoted to coarse fish, some to ducks or geese, some to frogs or nothing at all, and all of them were simply wasted, and most of them were thronged with insect life. These Mr. Andrews rented, and turned to valuable account, and, by a system of hatches and streams (which I deal with more fully presently), he can fill or empty any pond at the shortest notice, and that, too, without in the slightest degree interfering with the others in the set. And such is the capacity of these ponds that, in a pond of one acre in extent, he can rear 10,000 young trout from fry to large yearlings of from six to eight inches long in the space of a twelvemonth, with no feeding and no trouble during that time beyond keeping an eye on kingfishers and such troublesome visitors.

Of course, where one enjoys such facilities as these, it would be quite needless to incur the trouble and expense of a regular feeding process; but 10,000 fish, even though of gudgeon size, eat a good deal of food, and I should be disposed to think that the ponds would want a bit of a rest now and then, to let the food grow and accumulate again. That the fish under this method, after being put into, so to speak, virgin waters, where no trout ever have been before, do grow with a rapidity and vigour which is quite marvellous, is certain; for many splendid fish in the pink of condition, and of 2lb. and 3lb. weight, have been taken out of such ponds, having been put in as small fish, after only a year or two's residence there; and this should be a strong hint to the proprietors of nearly all ponds.

There are thousands of ornamental ponds all over the country, which hold nothing but nasty carp, tench, and roach, which give no sport whatever, and are utterly unfit to eat. Now, it is often said, "Oh, but our forefathers ate them, and the old monks cooked them because they were wanted for the

fasts instituted by the Roman Catholic religion; therefore the fish must have been eatable in those days, and why should they not be so now?" Well, there are many reasons why even these carp are less of "a deyntous dyshe," as Dame Juliana terms them; for a carp out of a pond, particularly a dirty, weedy, uncared-for pond, shaded pleasantly with graceful trees, is anything but a "deyntous dyshe," for a more utterly filthy and nauseous comestible than such a carp does not exist. If one could conceive typhoid reduced to a scaly creature, that would be about one's idea of it.

Now, let us go and look at this pond whence this fish comes, and see what we shall see there. Here is the upper end, where it is shallowish, being deeper at the lower, where the pen-stock is; the weeds are up to and above the surface; the trees on the bank wave over it. What is the bottom or soil of the pond composed of? Well, stir it up with the blade of your oar if you want to know, and we shall see. Why, what an exudation of huge bubbles of foul gases you have set loose, and what a mass of hideous black loathsome mud you have stirred up! May I ask when this pond was cleaned out before? "Oh, about fifteen or twenty years ago, eh!" Then we have here twenty years' accumulation of rotten weed, with saturated and decayed leaves deposited on the surface in layer after layer. You see and smell the result. The only wonder is that you do not get ague, typhus, cholera morbus, jungle or mud fever, and several other deadly complaints from even inspecting of it, and yet you expect this pit of Malebolge to produce you wholesome, well-tasting fish! Nothing good is produced without care and trouble. Bad things, of course, produce and reproduce themselves; and superior beings as we think ourselves, the quintessence of all the most highly-distilled and cultivated intelligence, there were few things in point of economical management and production in which the old monks (who in most cases made and cultivated these ponds) were not our masters; and

there is hardly a good thing or an institution or habit of any value in this country that we do not owe to the old monks. Anyhow, in the matter of fish culture we are infants compared with them. They, by the light of knowledge, skill, and industry, and, beyond all, necessity, got wholesome food in variety, sport, and pleasure out of their waters. We either turn them into sewers wholesale or pest houses like this pond, and get nothing but filth and disease from them. In the days of the monks rivers were crystal clear, gifts from Heaven to gladden and feed, not sewers, as half of them are now.

But to get back to our pond. Formerly the proprietors, not being able to get sea fish inland, turned inland fish to the best account. They kept their ponds clean, letting them run dry every few years to kill down bad weeds and to sweeten them by exposure to the air, and even in instances a crop of some sort was grown on the soil, thus turning the land to good economical purpose while cleaning it for further use. Thus in their chains of ponds they had a regular system of growth and cultivation, and in close proximity there was nearly always a stew supplied by a fresh, clear stream of water, in which all fish were kept for more or less time to cleanse and fatten. Here they were daily fed with bread, meal, or such substances as served the purpose, until the fish were seen be in the best possible condition, when they were taken out, knocked on the head, and cooked. They must have made carp good eating then, as they fetched a much higher price than even salmon.

Now, every fishery should have one or more stews in it. Last year I was fishing on some very famous waters which had for years enjoyed the highest reputations. These fisheries were paying the penalty of these grand reputations, and had become overstocked with big trout. You caught large numbers of trout, but not one in three was in what could be called in first-rate condition, while certainly one in three was in very poor condition. What was one to do? You

could not take such fish; and, though you returned them to the river, it was quite certain that they could do little good there, but would certainly help still further to diminish the food supply, which was already too short for the stock of fish they had in the river. I advised the proprietors to establish stews—and there were facilities for this in all directions. Into these they could instruct their keepers or their friends to turn poor fish instead of back into the stream; there they could be fed daily, until they came into fine condition, when they might be used either for the table at the house, or sent off to friends as presents, and they would then be of far better service and value than the half-fed, poor-fleshed fish from the river, while the fish left in the river would greatly benefit by their absence. I do not know whether my advice was or will be taken; quite possibly not; but that it was wise and sound advice, and that if it is not taken, or some other means are not adopted to thin the fish, there they will get in worse condition, and smaller and smaller still yearly, I am quite certain. There are few keepers who have not got a boy or two who could make himself useful in collecting slugs, worms, snails, water insects, beetles, &c., all of which would help to feed the stew; and with a supply of liver and chopped butcher's refuse, chopped fish, &c., there would be but little expense with much profit in my system. No fishery, as I have said, of any extent should be without a stew or two; and if you did not want the fish, as the season got on, you could take them out and put them into any select stream or bye-wash to breed, for they would be the best and the earliest breeders, and might easily be put in some suitably chosen place, where you could take the spawn if you wanted it. Thus the thing would serve various excellent purposes, while practically improving the fishery, And here is one more point worth notice. Some trout, as those of Loch Leven, fetch a very high price because of their delicate flavour and splendid condition. It is a mere question of food. Find

out the right food and you can make any other trout equally good. There are very few pieces of water, whether fed by springs or streams, which are not capable of growing excellent trout. Get rid of your carp and tench, then, and substitute trout. There are some few ponds where the water is stagnant, as the result of mere drainage, where possibly trout might not do, where the water "breaks" badly, and turns green in summer; in these trout might not thrive, but these ponds are rather the exception than the rule. The French used to have a saying to the effect that "He that had bream in his pond could bid his friend welcome;" and no doubt a really good carp bream of three or pounds weight, *with the assistance of French cookery*, might be made a really "deyntous dyshe;" but to our Anglican notions I am doubtful whether bream would be looked on as a satisfactory backbone in the menu of hospitality. A dish of nice, well-fed 2lb. trout, however, at will, is another pair of shoes; and there is not a country house with a pond or ornamental water of an acre or two and upwards in extent, that could not produce them very easily with a very moderate amount of trouble. Of course, where ponds are only fed by springs, the stock would have to be increased and supplemented now and then by fresh introductions from time to time; and when it is seen that 1200 trout of from 3lb. to 6lb. weight each, all in perfect condition, can be maintained in a pond of less than one hundred yards long and fifty in width, as is the case at Sir James Maitland's fishery at Howietoun, it is clear that the same thing, on a graduated and reduced scale, can be done in almost any instance elsewhere; given the water and all the rest, it is a mere question of care and feeding. Indeed, as has been often pointed out, water is more valuable and more productive, if properly treated and cultivated, than land. Wherever there flows any small trickling rivulet that can, by damming up, be converted into a pond, pool, or small lake, properly stocked with good species of fish properly cultivated, fed, and fished,

the area inclosed should be of very far greater value than the same amount of land; and if at any time it is wished to re-convert it, knock a hole in the dam and you will find your area so exposed far more fertile and productive than it was before it was converted into a pond.

As regards the introduction of new species of fish into this country, I doubt very much the utility. In trout, salmon, grayling, and char we have the best of their species, and in trout streams, with the exception of grayling perhaps, we want no other fish, nothing else pays so well. Of eels we can dispose of any quantity that can be got at high prices. If you want fish of the perch and pike kind, there are no better species. One hears much of the black bass. If the black bass would do in waters like those of Norfolk, Lincoln, and the Trent (and why shouldn't he?), by all means have him, but not in any trout streams. The little toothsome gudgeon will thrive and increase anywhere; I have had them do so in a horse pond. And in these we have excellent stocks that cannot be improved on, and I do not think that any fresh introduction, beyond what I have stated, would be worth the money it would cost. If all our waters were thoroughly and adequately stocked with the best of the classes of fish which we have already, and which are suitable to them, we should probably quadruple or quintuple our fish supply; but a vast deal remains to be discovered, and learnt, and done, much wrong redressed, and much prejudice dispelled, before ever we shall arrive at that. At present, therefore, I think we need not much concern ourselves with the acclimatization of new species. In the increase and development of fish food, and in the crossing and improvement of the best breeds, the substitution of the best species for more indifferent ones, and the stocking of wastes of barren waters, we have before us as much work as we can well carry out for the next dozen years, and sufficient for the day is sound wisdom.

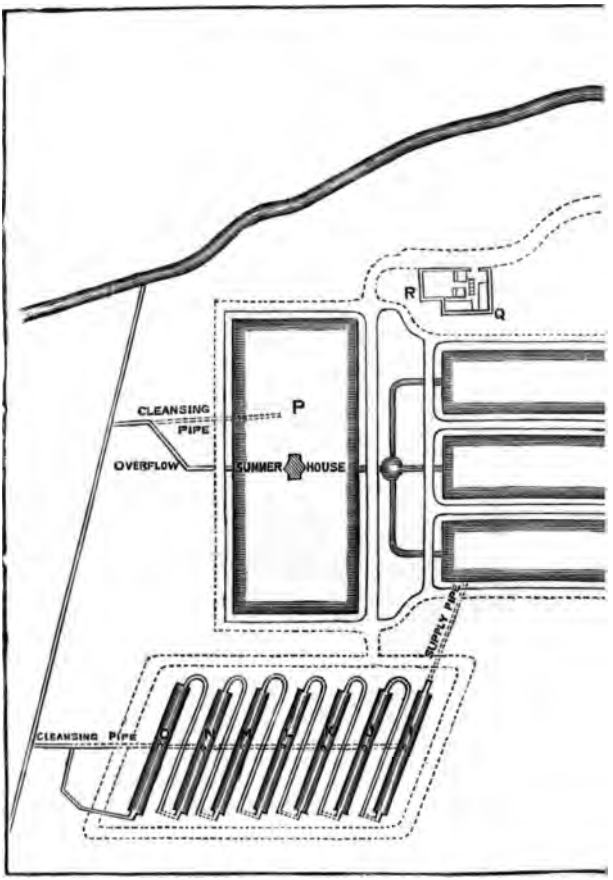
# CHAPTER VII.

## SOME HATCHERIES.

SOME account of one or two of the leading piscicultural establishments in the country may at least be found useful as showing how the different systems are carried out, I have, therefore, given accounts of two visits which I paid some time since to Howietoun and Guildford, and added two engravings which I then got, and to these I have since appended a brief notice and sketch of Mr. Capel's place.

I had often been asked to look over the establishment at Howietoun, called into existence by Sir James Maitland, Bart. At first it was started from pure love of the science and a desire to help neighbours, for Sir James is an enthusiast; but, as the place grew and grew by a sort of natural and necessary extension, and one thousand after another of current coin became sunk in it (the expenses also rapidly increasing), it became necessary to turn it into a public institution; and now, as a means of supplying the public necessity in respect to restocking fisheries, it may vie with any in Europe. During my visit to Glasgow, in 1881, I took the opportunity of running over to Stirling to look at Howietoun; Sir James very kindly conducted me all over it, and explained everything, and I gave the account of my visit, as it occurred then, in the *Field*, though I went all over it again in 1882, when, I may state here, there was no great alteration—a pond or two had been added, and the large incubating house was finished, but there was no alteration.

The first place we went to was the new hatching house. This was not then complete, but was to be quite ready by the spawning season. It is a handsome erection of brick and


R
Q
CLEANSING
PIPE
P
OVERFLOW
SUMMER HOUSE
SUPPLY PIPE
CLEANSING PIPE

stone, of considerable size, irregular in construction—a necessity caused by its position, &c. Sir James is his own architect, and looking at the irregularity of the windows, I ventured to think an architect would look on them as contrary to all the rules of science. Sir James smiled, and said, "Yes, the plan of it drove my architect frantic when he saw it; but it is necessary for the convenience of the fittings and machinery within that it should be so," which was evident. The building contains four rooms, two below and two above, each of which is 40ft. by 30ft. There are forty hatching boxes in each of the three rooms, each 6ft. long, four panels in each box. The grilles in these panels are each three feet long, and capable of holding thirty-three eggs, without touching, in width, Each box holds twenty thousand eggs. Sir James prefers grilles to gravel, or any other bed. They are cleaner, give better numerical results; hatch out quicker, and are easily cleaned and replaced if broken. In the fourth room are six large rearing trays, where the fry remain till ready to go to the ponds. Besides this, there is still the old hatching shed remaining. I had not time to look at that. In each of the above rooms at the upper end the water passes through an ingeniously contrived filter, each 7ft. 6in. long by 3ft. wide and 5ft. 6in. deep. The frames of the boxes, &c., are all of wood, charred on the inside to prevent conferva, &c. They are re-charred every season. This is found to answer much better than slate, stone, or pottery, and is undoubtedly far cheaper and less trouble.

Howietoun is very favourably situated for water. There are two sources of supply—one a plentiful spring, which comes off a limestone bed, and, always running beautifully clear, with little need of filtering, does for the more delicate hatching operations; and the other a burn, originally coming from a hill loch, Loch Coulter, and flowing into a reservoir, which always contains 144 days' supply of water for the establishment.

And now we come to the printed plan, kindly traced for me by Sir James. At the upper end is a sluice, marked A on the plan. This sluice is a double one. On one side a 12-inch pipe, defended by coarse perforated zinc, with a side waste, this feeds the large ponds; and beside it another of 10in. to the pipe, worked by a screw, with much finer zinc, which feeds the smaller fry tanks. These pipes are dotted on the plan. Letter B is a small pond, about 60ft. long by 15ft. wide, and 5ft. deep. All the ponds are about 5ft. deep I may say, that depth being found to be essential to keep the fish in good condition. B pond held 1000 burn trout, hatched in 1876; and very fine burn trout they were, running over three-quarters of a pound on an average, but preserving the colour, marking, and general characteristics of the burn trout to a remarkable degree. Throwing in a handful of mince-meat, which set the shoal plunging and dashing about, Sir James plunged a big landing net in, and brought it out three-parts full of golden and copper-coloured beauties, which, when we had sufficiently admired them, were returned to their pond. Ponds C, D, and E are each about 130ft. long, by 15ft. or 16ft. wide. The first contains 1600 Salmo fontinalis, hatched in 1880; the second 600 fontinalis, hatched in 1879—all in most beautiful condition and perfect health. And this is the more remarkable because there was a sort of epidemic amongst fontinalis last season. E pond contained 9000 pretty little Loch Leven trout of 1880. F, G, and H are three more important ponds. They are getting on for 300ft. long, by between 40ft. and 50ft. wide. F contained 4600 Loch Leven trout, hatched in 1876, running from 1lb. to 3lb. weight each, fully averaging 2lb. It was a splendid sight when a net full of these fine fellows was taken out for inspection. G pond held 5000 Loch Leven fish, hatched in 1877; they ran from ¾lb. to 2lb. H had 5400 of the same fish, hatched in 1878, weighing from 4oz. to 1lb. each. The chain of little ponds at the side are about 100ft. long by 10ft. wide each. I held

only dace; J 6000 Loch Leven fry; K the same; L 7500 fontinalis fry; M 6000 Loch Leveners, N the same, and O 10,000 salmon fry.

P is *the* pond. In the middle of it is a charming summer house. We got into a small boat, and ferried across to it. It contains a cellar, a delightful smoking room, and above a sort of open verandah, or observatory. This pond is 210ft. long by 90ft. wide, and holds 1400 Loch Leven trout, hatched in 1875, and ranging from 2lb. to 8lb., with a solid average of 4lb. Now, you do not see 1400 4-pounders all together every day. We took a gallon or so of mussels over, and fed the fish out of window, and to see these monsters dashing about was indeed a sight. The 3 and 4 pounders dashing to and fro were amazing in their rushes, but every now and then a 7 or 8 pounder would wallop up, and he dwarfed the others by comparison. The vigour, health, and beauty of these fish, confined in so comparatively limited a space, was surprising.

Now, here comes the point. Here is a small pond, 70 yards by 30, and in it you can maintain 1400 trout, averaging 4lb. each, in the height of condition, and in beautiful order, and fit for the table.* Is it not clear from this that any ordinary lake in a nobleman's or gentleman's grounds can be made to carry any number of fish you require for either sport or table, provided they are properly and duly fed? It is, as I have always maintained, wholly and solely a question of feeding, and what so easy to feed as a trout? He will eat nearly anything, from bread to cockroaches, and even clover heads don't come amiss to him, for Sir James said: "Did you ever see a trout eat clover?" I replied in the negative. He thereupon picked half a dozen heads of red clover from the grass and threw them on the water, and the big fellows came at them

* Each trout thus has 1½ square yards for his share, there being 2100 square yards in the area of the pond.

like tigers, and even when you pulled the heads to pieces and scattered the petals on the other ponds, the small fish would take them just as greedily. These larger fish of course are kept as stock fish, and supply the ova which is needed for export. Sir James is a most skilful manipulator, and sometimes spawns them himself; I forget how many he said he spawned in five minutes once, but it was something most unusual. I may note here that, though the progenitors are lake fish, the breed does quite as well for a river.

But to return to our plan. Q is the packing and despatching house, where the ova is packed and sent off. There is an ice house adjacent. U is the mincing house, where the food is chopped and prepared; this consists chiefly of horseflesh and mussels. Many sacks of the latter are always on hand, and three women are engaged constantly in opening them and taking them out of the shell. They often, too, cut up three horses in a week, for the fish are rare good trenchermen. T is the tank house, where all sorts of apparatus for conveying fish, &c., is stored.

The whole place is beautifully kept, neat mowed lawn, and brick-edged ponds. It is quite a sort of fancy place, and yet all the fancies are more or less practical, and have one object. It is surrounded by a high paling, which once or twice marauders have sought to surmount, but they have been dealt with in such a fashion by Sir James that they are now very shy of the place. Besides all these ponds shown, there are two long ones up near the house, which hold some 40,000 fry. There are now other ponds beyond the summer house pond, as orders increase, and the needs grow more and more every year. When I was last there Sir James was making a large pool, or rather a small lake, some little distance off.

The following letter, just received from Sir Jas. Maitland, will give some idea of the work he is engaged in :—

"Craigend, Stirling, 29th March, 1888.

"Dear Sir,

"I can now give you approximately the numbers for the season. We disposed of about two million eggs (this includes about two hundred thousand given away), and I have now about a million and a quarter fry in the two houses in the 7ft. boxes, and about a quarter of a million in the 20ft. pond, making over three million and a half incubated this year. These numbers are nominal; an actual count would give at least half a million more. The eggs measured rather over a hundred and fifty gallons. The loss has been heavier than usual, being slightly over three per cent.; but this is easily accounted for, by my having to train young hands, and not being much in the house myself. I ought to explain, the new house was not fully furnished with boxes at the beginning of the season, and I expect to incubate nine million this autumn. There were two boxes of salmon, nine boxes of fontinalis, and twelve boxes of fario laid down, the remaining 277 boxes were Loch Leven. All the ova except the salmon were obtained from my own ponds. There were also several boxes of hybrids.

"I have sold this spring 50,000 yearling trout, and could have sold more, but have not got them, and have only a few yearling fontinalis left. There have been only two cases of serious loss. In attempting to stock Tiree the steamer was driven back by a storm; the fish (2000 yearlings) survived till the third day, when they all succumbed; and the only lot of fry (5000) I have yet sent off succumbed from the bottom of a new tank coggling and knocking them all to pieces.

"Yours very sincerely,

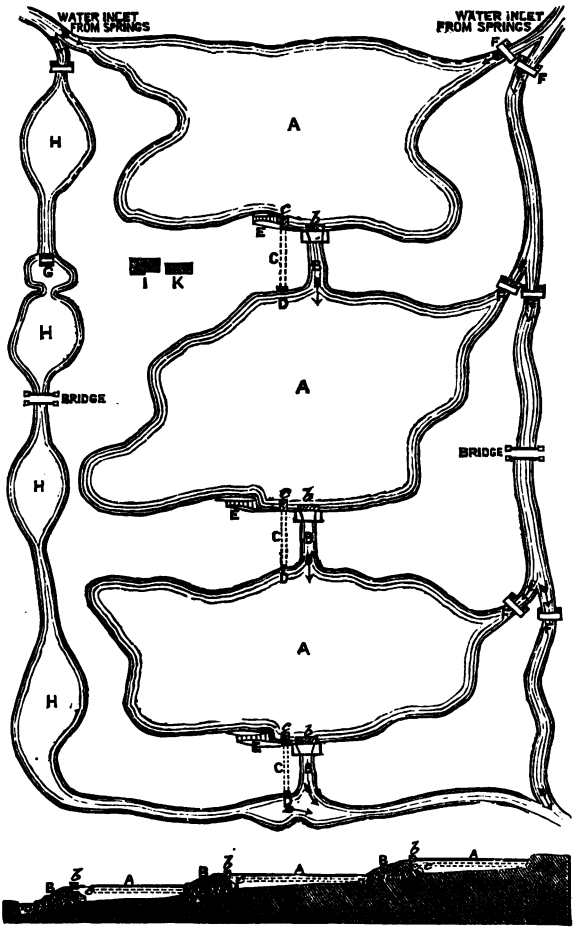
"J. R. G. MAITLAND."

## MR. ANDREWS'S METHOD.

I visited Mr. Andrews's piscicultural establishment at Guildford in 1882. Mr. Andrews pursues a different system from

that of Sir James Maitland. Sir James keeps his fish in small reservoirs, and feeds them constantly. Mr. Andrews lets them find their own food. All over the county of Surrey there are numerous ponds, and little rills in any number that trickle between the low hills. Some of these have already been extended out for mills, others show a capital opportunity, from the lay of the ground, for making ponds, by the simple operation of throwing a dam across some shallow gully, and putting a hatch in the middle of it to regulate the water. In some cases another dam and hatch lower down, and even another and another are added, and chains of ponds are made, three, four, and even more in number, and supplementary rills along the sides are added, as shown in the engraving appended; and these being suitably sluiced can be worked so as to command the supply to any particular pond in the chain of ponds, which can thus be emptied and fished, or mudded if need be, without interfering in the least with the other ponds. The fish, of course, often escape into these rills, but the rills themselves are fitted with a brick trap and hatch, as in well-kept water meads, every fifty or sixty yards or so, so that each length can be dried up in two minutes, and all the fish taken out. In this way Mr. Andrews rears large numbers of yearlings for stocking purposes, and he does not care to rear larger fish, except for his own use as spawners; and of these he has suitable depôts.

Mr. Andrews does not feed. That trouble and expense he professes to save; but, of course, he requires a far larger area to rear his yearlings in; probably a pond of an acre in extent will hardly rear more than six or seven thousand yearlings. Mr. Andrews has in his hands some forty ponds, all at various distances round Guildford, from half a dozen to a dozen miles off. He certainly produces a beautiful breed of fish, and finer yearlings than I saw 1500 of in his store tank at Westgate House, waiting to be sent off to various customers—he having fished a pond which I visited with him, and taken




(A) Fish ponds.
(B) Overflows, guarded by wire fences (*b*).
(C) Pipes from bottom of ponds to draw off water guarded by wire screens (*c*).
(D) Valves to ditto, to be kept under lock and key.
(E) Steps from banks to bottom of fish ponds.
(F) Penstocks to divert water supply, with foot bridges.
(G) Waterwheel.
(H) Pools for rearing young fish.
(I) Keeper's cottage.
(K) Fish hatching house.

7000 yearlings from it—I would not wish to see. Many of them were 7in. and 8in. long, and that is as good a result as one could wish for, while he showed me a few two-year-olds that were over ¾lb. each. Such results are satisfactory as far as the fish go, but as a matter of course, though Mr. Andrews escapes the cost of feeding, he has to pay a good deal in rent and the travelling to and fro to the various places. The carriage of fish, nets, and apparatus, the number of men needed to look after the various places, &c., all must be set against the one cost of feeding. Of course, not having actual figures, it is not easy to strike a balance as to results. The only thing to say is, that each person who sets up an establishment of this sort must be guided more or less by the natural facilities which are to be found around him. The best engineer is he who can turn Nature to the best account. No two systems can well differ more materially or widely; possibly each may be satisfactory to the pursuers of them.

Mr. Andrews's home establishment is merely a hatching place, constructed in two stories, out of what was once probably an old orchard house, which has been suitably enlarged and made into two stories to economise space. Here there are numerous ranges of slate tanks in which the ova are incubated, for Mr. Andrews uses no grilles nor gravel, but merely the slate tanks themselves, which are set in ranges of five or six, a thin thread of water sufficing for all the purposes of incubation. In some cases the eggs are placed in trays of perforated zinc, and these are placed one on another, and the supply is forced up from a small pipe at the bottom which surrounds the main tank, and which is pierced with holes. In this way a very large number of eggs can be incubated in a very limited space indeed. Of course, when the fish are hatched, they require more enlarged quarters, but as soon as the sac is absorbed, and the fish are ready to feed, they are either sent away or carried off to one or the other of

Mr. Andrews's sets of ponds, where in time they become valuable yearlings. The water for the hatching is supplied by the town, and is pure and of low temperature, seldom rising much above 45°. Besides these hatching trays there is an artificial tank capable of holding a good many fish while they are being sorted out and sent away.

The perforated zinc trays are also made to fit into the hatching trays, so that a certain number of fry can be kept in each, ready to be turned out at a minute's notice when wanted to be sent away. For purposes of carriage of fry and yearlings, Mr. Andrews uses principally large wicker-clad carboys, which he finds answer his purpose well. He finds that the fish will live a long time in carboys if they are not allowed to stand motionless too long, an occasional shake-up being necessary.

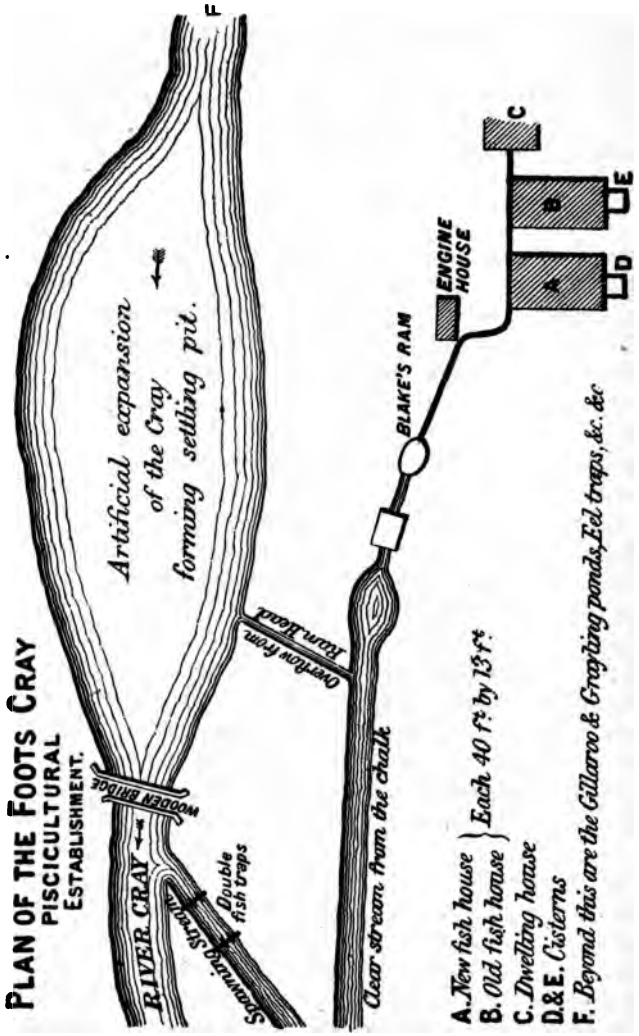
As a rule, Mr. Andrews confines his business to ova, fry, and yearlings; whatever stocks of larger fish he has he keeps for spawning purposes, they being more valuable to him in that shape than for purposes of sale. Mr. Andrews has also a very good opinion of the *fontinalis*, but does not seem inclined to add the black bass to the list of fish which he operates on. One great advantage Mr. Andrews enjoys is the situation he occupies. He is in a centre whence a large number of waters, which more or less require his assistance, can be reached.

I am sorry that I have not also a detailed plan of Mr. C. C. Capel's establishment at Foot's Cray; but, unfortunately, whenever it has suited me to go to see it, Mr. Capel has been either from home or unable to see me, and when he could have me I have been unable to go. There was a very nice little description of his place in the *Illustrated Sporting and Dramatic News* the other day, from which I gather that Mr. Capel raises the water and feeds his hatching and rearing trays by means of a Blake hydraulic ram. This difficulty of getting the water up to a suitable level for convenient distri-

bution is always one which exists more or less. Often it is overcome by leading the water in pipes from some distance. Mr. Capel uses perforated zinc trays instead of gravel as a bed for the ova. Mr. Capel has a speciality in his breed of gillaroo trout, of which he was fortunate enough to secure a good hatch from Loch Melvin some years ago. On some lochs the gillaroo is more a matter of curiosity than advantage, much no doubt depending on the character of food they enjoy. The only place I have ever taken gillaroo upon was Loch Melvin, and then I got none over about 2lb. weight, though I have heard of far larger ones being taken there; but they were (as it is said in this notice of Mr. Capel's stock) extremely handsome, well-shaped fish, brilliantly marked.

Mr. Capel has a variety of breeds in his stock; not only has he the native fish of the river Cray, which are said to be exceptionally late spawners, nearly, if not quite, as late as the Wandle fish. He has also spawn from Loch Leven, and stock from the Colne at Hertford, besides *fontinalis*, which he has been trying to cross with trout. A previous attempt, we are told, failed. I look upon the *fontinalis* as a charr, and am not surprised at the failure, whereas I believe that it has been crossed with other charr successfully.

Another speciality which Mr. Capel has is a fish trap for trout which are pushing up to spawn. A small clear brook enters the river in his domain. This, which is a very favourite spawning ground with the fish, has an arrangement of little weirs and gratings contrived upon it, and so arranged that the fish can push up a certain distance into a pool some 20ft. square, and once in that they can neither get further up nor retreat, and thus when the keeper comes to inspect the pool he often finds twenty or thirty fine trout ready to his hand, and often fit for stripping. The main river, however, is sometimes plagued with pollutions. A good deal has been done to arrest this nuisance, but something still remains to be done. I remember Foot's Cray when the little inn by the bridge had


PLAN OF THE FOOTS CRAY
PISCICULTURAL
ESTABLISHMENT.
RIVER CRAY
WOODEN BRIDGE
Double fish traps
Overflow from Farm Head
Artificial expansion of the Cray forming settling pit.
F
Clear stream from the chalk
BLAKE'S RAM
ENGINE HOUSE
A
B
C
D
E
A. New fish house
B. Old fish house
} Each 40 ft. by 13 ft.
C. Dwelling house
D. & E. Cisterns
F. Beyond this are the Gillaroo & Grayling ponds, Eel traps, &c. &c

a right of fishing over a good stretch of stream, and you could, as at Farningham, enjoy a day's fly fishing by simply putting up and dining at the house; and I have seen remarkably fine fish taken out of that water, a brace or two before dinner of 1½lb. fish being a common occurrence. But those halcyon days have long departed.

# CHAPTER VIII.

## COARSE FISH.

I AM reminded that there is a very large section of the population which is interested in coarse fish; that there are many rivers, &c., which do not carry trout at all, and that it might be useful to *ces autres* if I said something in respect of those fisheries, Well, provided these inferior fish are not permitted to monopolise the places of their betters, I am quite as desirous to forward the sports and pastimes of my poorer fellow-subjects as they can be themselves. Someone has asked, "Pray, what is a gentleman without his recreations?" I think the question is much more pertinent, "Pray what is a poor man without *his* recreations?" and this question is of very much more importance to the body politic to entertain than the other. The gentleman can get them if he likes by paying for them; and if he has not *vim* enough to go for them, it does not much matter what he is; he will probably be a nonentity, which is little more than an eating and drinking machine. But, inasmuch as the poor man cannot well get what is not extant, it is of consequence to all of us that it should be extant, as a poor man with no recreation but the public-house, becomes not only brutal, but dangerous.

Now, I suppose the next best fish to trout are pike and perch, taking sport and table value together. There are not many secrets in respect to the preservation of pike. One is to respect the undersized fish, if you desire to keep up a stock of them of decent size; and in no public water should a pike of less than 1½lb. be allowed to be killed; 2lb. would be

better, but a 1½lb. fish is a sore temptation, and few poor men could be induced to restore such a fish; but below that size—a size which is represented fairly by a measure of 17in. —I would put my foot down rigorously, and say, it shall not be done. On the Lea, I believe, a pike of three to the pound, or less, runs a very poor chance indeed; this should be stopped most promptly. On private or club waters I would say 4lb., or 24in., which is not a bit too small for such waters; and I would permit no gorge-fishing at all. It is not at all necessary, for gorge-fishing savours too much of dead-line or trimmering; and a well-arranged snap gives better sport, and does not kill the fish. Some anglers will say here, "But how can we fish the weed-beds in summer?" Do not fish them at all if this beastly way of fishing is to be permitted. Wait till the winter, when the weeds are down, and the fish out of them. The fish will not run away; you only give them a few weeks or months' law. I often wish that old Nobbes, who has been called "the father of trolling," had never written a line. The very sight of a dead gorge-hook is enough to make one shiver—"the father of cruelty" would be a better name for the inventor—while the method is tedious to a degree, and wholly unsatisfactory.

It is a great advantage to pike to have a variety of food. A regular supply of roach, say, must more or less jade upon the appetite; and an occasional rat, mouse, frog (not skinned —*pace* Nobbes for crayfish), or other edible, gives variety and piquancy. Pike, particularly big ones, do not feed so often as people imagine; and if a big pike gets hold of a good 2lb., 3lb., or 4lb. fish, he swallows it by degrees, like a boa constrictor; the head goes in first, and when that is digested the body follows inch by inch; and you may pull a fish out of a pike's mouth, half of which is digested, while the tail part is still solid and firm. Such a dose will often last a pike for two, three, or four days, and thus it is that people so often fish for good pike which are known to haunt certain spots, and

don't get a run from them. They are probably reposing in some hole under a bank or big weed, with a large tail of a 2lb. trout or chub sticking out of their jaws. We caught four at Winchester in one day—8lb., 6lb., and 5lb., &c.; the three biggest had trout of 1½lb. and 1¼lb. and 1lb. in them. These fish would probably not feed again for two or three days. I take it that a pike will eat his own weight in a month easily.

Pike need protection most when they are spawning. They will go into any shallow, weedy ditch, or rush bed, and splash about there most ostentatiously, to give notice to the nearest yokel that they are open to be caught by any implement, from rake or pitchfork to a hare-wire, and hundreds are raked out, stabbed, and snared from these places every year on the banks of the Thames alone, when they are mere carrion. Then, when they have spawned, down come Farmer Giles's ducks, who know all about it. "What a fine lot of spawn. Quack! Let's eat it." They eat it, and where is your next year's brood to come from? A stray pellet or two may escape their quick sight among the weeds, but the great mass is destroyed, and what the ducks do on the ditches the swans do ten times worse on the rivers. If you will destroy all the eggs, how on earth are you to have chickens? A few yards of cheap wire-netting drawn round the spawn then would protect it from all these sorts of foes very easily. It might be moved in two or three weeks as they hatch very quickly, or you might remove the spawn to a safer locality.

What I have said on this head as regards trout is ten times more applicable to coarse fish. The perch, for example, hang their spawn in long ribbon-like folds on the roots of trees, in quiet eddies under the banks or still backwaters. It has not the ghost of a chance when the coasting ducks and long-necked, prying swans come along. It is spied out and devoured in an instant. Were it not for this and the horrid wash of the steam launches, the Thames would swarm with

perch fry. Collect the ribbons, cut off root, branch, and all, and convey it to some quiet backwater, where it can be safely protected for a fortnight.

Then again, the waterworks suck up enormous stores of the fry, but if they allow the fish when full grown to be taken out by the T.A.P.S. and restored to the river, they return good for evil. Pike are very cannibalic, and are very fond of feeding on their own progeny. There is no better bait for a 20lb. pike than a 1lb. jack. They will eat one another with all the pleasure in life, as every pike-fisher knows, and that ½lb. or 1lb. pike should be scarcest in a pike fishery is not so strange as it might seem. A nursery for young pike would be a useful though a difficult matter as a feeder to large water. There is nothing else to be learnt in pike preservation beyond this. When you stock a large piece of water, don't do as a friend of mine did, who, having stocked his lake with a hundred and fifty nice store 2lb. jack, at a cost of at least 7*s.* or 8s. each, gave leave to fish to a gentleman of the hair-cutting persuasion, who went and took out promptly above a score of them, and did not return them to the water again, but made presents to his friends. My friend heard of it, and when the noble sportsman came to tell him that the date of his ticket of permission was out, he replied, with a brevity which was beyond praise, "Oh, is it!"

It is a common error to think that pike love great endless deeps. Pike like a deep hole or eddy to live in, but they like shallows to sport on. Deep holes, caverns for rest and digestion, but a nice shallow where the small fish lie and form a pike's larder, with a gradual ascent to them, on the edge of which pikey can rest, with his cold grey eye picking out a suitable victim for his maw as soon as his appetite is quite fit; that is what they really like, and you never will have a big stock of fair fish on your mile-long, forty-yard-wide, twelve-feet-deep mill head. A few real big'uns may rest there, but not many. For why? Fee, Fa, and Fum object

to it, and if they do see an outsider they request him to "come in" promptly.

As regards perch, the difficulty too often is to reduce their numbers rather than to increase them, if they have fair play. For unless ducks, &c., get at the spawn, there is nothing else to keep them down, for the pike, though he will take them at times, is fonder of fish that is not quite so spikey and well armed, and, consequently, they very much escape that danger. It is very common to find waters thronged to repletion with little miserable perch, not five inches, and often not four in length; and these you can catch with a couple of bits of worm on two hooks, two at a time, as fast as you can haul them in, the take often being numbered by hundreds, but you don't get a three-to-the-pound perch among the lot. In cases of this kind you may be sure that the stock of perch is far too large, and that the deportation of a good half of them to waters which are short of perch would be largely for the benefit of both.

A perch is a very ravenous and large feeder, and wants a good deal of food to keep up his growth and condition; and this you may always be sure is the case with all fish which develope such prodigious roes and such a vast power of increase as the perch does. Look at the roe of a perch in the end of February, it is tremendous, and all this needs support in the way of food to bring it to perfection. The spawn of perch, as I have said, more especially on the Thames, comes to the most comprehensive grief. Were it not so, the stock would be something prodigious. Above the swan latitudes, up away by Wallingford and Abingdon, used to be my happy hunting grounds for perch formerly, and the stock there then, owing to the absence of swans, was abundant. I have frequently taken much over ten dozen of good perch, with some two-pounders among them, in one day, and I once took nearly that number above Abingdon out of one eddy; they ran about two, three, and four to the

pound. But those times are gone; the steam-launch demon washes off the spawn and destroys it quite as much as the swans do. Perch spawn hatches very easily in confinement, but it is not so easy to rear the fry.

I always put the Kennet down as the first perch river in England. I once fished with my friend H. A. Simonds on a fine private water on the Kennet, which we used to get a day on when in order; our take was thirty-seven perch, which weighed 60lb.—many over 2lb. each in weight. My friend had three perch on his paternoster at the same time (we fished with three hooks) he landed two of 2lb. and 2¼lb., while the biggest of the three, which was on the top hook, broke away; and these Kennet perch are as good for the table as they are for the rod. A well-cooked 1½lb. perch, broiled in his skin and scales (which comes off *en masse* when cooked), and his white flesh gently buttered, peppered, and salted, with a squeeze of lemon, is a dish "only fit for anglers or very honest men," as Father Izaak says.

Chub, barbel, and roach all spawn on the gravel.* A gentle shallow a foot or two deep, with not too swift a current, will attract all the fish for a long way below during the month of May. Now, to give some idea of how the spawn of these fish is destroyed, I will relate a fact which I saw with my own eyes. Many years ago I lived at Wycombe, and I went over to Marlow in the month of May, and stayed at The Anglers to have some trout fishing. Down below the weir pool some little distance, there is, or was, a shallow such as I have described, and about seventy yards long or so. I was trying the streams with a fly for trout, and seeing something moving on the tail of this shallow, I pitched over it, and, seeing what I thought was a rise, I struck and foul-hooked a pound roach. I did this two or three times, and then I found, on

* A friend says that the roach spawn on or among the weeds which grow on the shallows. That may well be also.

further close inquisition, that the shallow was covered with roach, chub, and barbel, according to the depth and strength of the stream, all hard at work spawning. I was much interested in the spectacle. There were hundreds of them at work—all the finest and biggest fish, in fact. No sooner had the fish done spawning and dropped away from the shallows than a troop of some twenty swans, headed by a white-headed hoary old villain, who was the leader, came up, and perched themselves on that shallow. Do what you would you could not drive them away; you might stone them off for a minute or two, but they soon returned, and they ripped up that shallow from end to end, and for more than a week these twenty swans lived and fed on that shallow, and as long as there was an egg to be raked up they never left it. I take it that they must have devoured a good barge load of spawn in the time. It was the stock of all the fish for miles below, anyhow. That I saw myself, and I have no doubt it goes on on every other shallow as well, wherever there are any shallows left, and there are few enough, thanks to the tremendous energy displayed by the Conservancy in sweeping away those indispensable portions of a fishery, the shallows or spawning beds. If canalisation goes on as it is going, there will soon be none left, and no fishery either. What is the use of making regulations or laws against poaching in the face of this awful destruction? It is mere tweedledum, tweedledee. If only twenty yards square of this shallow could have been fenced off with wire net for three weeks or so, immense saving would have resulted.

The chub, though he is not A 1 for the table, is a very sporting fish, and dear to a large class of people. He takes a fly nobly, and fights very respectably; and before the steam-launch fiend ruined it, fly-fishing under the boughs for chub on a warm August day was one of the most delightful amusements possible for a used-up Londoner. I have killed a hundredweight on an August day between Abingdon and

Wallingford, with my friend H. A. S. and Champ for boatmen. But now, the first beastly tea kettle that comes tearing along washes them head over heels into their holes for the rest of the day, and it is all confined to pith-and-brains fishing in mid-winter, when steam launches are not found to be so indispensable as in warm weather, and this is not the same thing, but is a dreary, not to say nasty, phase of sport, although it is unquestionably a very killing one. There is little that can be done for the protection of chub beyond setting a half-pound limit or so to the takable size of them.

With regard to barbel, the last direction for chub is a very important one; hundreds of barbel are caught when of mere gudgeon size, either when raking for gudgeon or cast-netting for bait. They make a capital spinning bait, being so tough and untearable. But they ought not really to be killed under 1lb. weight; a barbel less than that, though he may give some fair sport on light roach tackle, yet, when you have got him in, of what use is he? If you cook him, he is all bones and slop. The only use he is, is to weigh in at a competition; and if you wanted the strongest possible condemnation of competition for gross weights, you could not have a much stronger one than this; for, as I hold, it has been more or less the ruin of barbel fishing on the Thames. I never had anything to do with such matches, and therefore, though I have in my time caught hundreds of wells full of barbel, I have almost invariably turned them back again into the river, for I had literally no use for them. They afforded me a day's capital sport, and I turned them back none the worse for a few hours' detention, to serve some one else's turn. Formerly, when barbel were more abundant than now, the takes were often prodigious. I have known Jemmy Hall, in Richmond Deep, take over ninety barbel in one day. They all ran small, however—pounders, or less. The great fault in barbel fishing is, that it begins too soon on the Thames. It ought not to commence till mid-July or August. It is a

common thing in June to catch the barbel with the spawn or milt running out of them, as they feed quite ravenously at such times. The big ones take spinning baits at the weirs even in May, and after they have done spawning, a month or six weeks is none too much to let them mend their condition in; and, by the way, the same may be said of pike. They are taken, by law, far too soon, and, being greedy tykes, they are always on the feed.

Roach can take pretty good care of themselves, *if you only give the undersized fish a fair chance.* The good ones keep in the weeds all the summer, and seldom feed well till late in autumn or winter, when the weeds get sour or rot; then, if you put in the small ones, you may do all you know till the end of March, when they should be left alone again until July at least; but it is the taking of the small ones in the summer that is the mischief.

For all these kinds of fish the rules of protection are very short and simple. First, have an ample fence time; and, secondly, be very particular not to catch or permit the catching of undersized fish, and to keep ducks, swans, and steam launches in abeyance. If you do this, fair angling will never hurt your rivers. Don't catch the fish when they are mere carrion, and rabid with hunger and exhaustion after spawning. Give them a month or six weeks to recover their strength and wariness, and don't take an unfair advantage over weakness and starvation. You will then, by such reasonable abstention, ensure that you have a fair share of tolerable sport all the season through; but if you will catch all the stock when they are not fit to catch, and when there is little sport in it, it serves you quite right if you lose your sport altogether. The bad fence time, with the killing of undersized fish,* the canalisation carried out by the con-

* When I speak of the killing of under-sized fish, I may perhaps as well give an exemplification of what I mean, and show to what extent this abomination has been carried. Several years

servators; the swans, and steam launches on the Thames, have ruined the fishing, which it is almost a hopeless task to attempt to revive it while these things exist; and nothing but an extended close time and the most rigid rules will ever help it at all.

Other rivers, of course, are otherwise affected. In Norfolk, netting and poaching on a very wholesale scale are the things which do the mischief. This can be tackled by organisation and decent laws. Angling societies, which are now becoming so almost universal, may do a good deal to help their fisheries, if they will avoid the worst and most destructive forms of competition. And if they will (no matter what the laws may be) only make fair and sportsmanlike rules of conduct, and observe them themselves, they have very much the case and the power in their own hands in respect to all these river fish.

Carp and tench are rather exceptional fish; as regards them, the same thing applies. Give a proper fence time and return under-sized ones, and you may fish all you know without doing any harm. There is, however, one curious thing as regards carp which needs attention, if you want to keep up a succession of stock. It is one of the commonest things to

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ago, when the river was changing from good to bad, I went fishing, in the month of July, to Hampton Deeps. All we could catch was small roach. They bit like mad, and opposite to Garrick's Temple I had three days at them. The first day I caught twenty-three dozen, the second, twenty-seven dozen, and the third thirty dozen of small roach, not one of them six inches long, most of them not five. I returned the whole of them to the water at the end of the day—eighty dozen, or nearly one thousand roach in three days. The next day a friend came to fish with me in the same place. We caught twenty-five dozen. I was going to turn them back as before, when he objected. He produced a sack and put them in, and took them away. What use they were, unless to weigh in, I cannot conceive; but when you could, as you could then, catch fish like this, it is easy to see how the vast stock which used to fill the river has been reduced.

net a carp pond, and to find a large number of good-sized fish —fish from 2lb. to 4lb., or from 6lb. to 10lb., but no small ones. You naturally wonder, Where do the small ones get to? Carp are not cannibals. It is a very curious fact, but I have seen it with my own eyes again and again, when a big carp comes on to spawn, she will meander about over the weed on which she casts her spawn; and you will constantly notice two other carps—a size or two smaller, perhaps—following her everywhere, and devouring the spawn ravenously *as it flows from her*. I have seen it over and over again in our aquarium tanks, where you could not mistake, or I would not have believed it. What you are to do in such a case it is difficult to say—it quite accounts for the absence of small fish; but whether you should isolate the spawners to get brood or no seems rather a moot question. Where you find small carp, you find them all small; and where big, all big. This is rather a puzzle, and always has been.

They have some very fine species of carp in Germany—in the Leather carp, a fish more like a tench in its skin than a carp, and the Spiegel or Mirror carp, a most singular fish, with irregular scales, some as large as sixpences, on the side; and they are said to be very superior to ours for the table. How this may be I cannot say. I had them both at the Brighton Aquarium under my charge; they were handsome fish, but I never ate them. Then they have a fish called the Orfe, which is a small kind of bream, seldom going over 1lb.; but it is much prized as an edible fish by those who live on the rivers, who prefer it to any others. I mention these matters, in case anyone may wish to improve their stocks of these fish; but to make them worth eating they must, as I have already pointed out, treat them rationally.

There are two other fish worth notice, not on account of sport, but because they are such excellent table fish. First, cray fish, common in many parts of the Thames, and most of its tributaries. These fish are exceedingly fine in Germany,

and I have seen them there twice as large as I ever saw them here. As a delicacy they are beyond praise, and as they do not require much attention, and only a limit as to size, they should be cultivated in all streams. Then there is the burbot, barbolt, or eel-pout, common in the Trent latitudes, and some of the Lincolnshire and Cambridge waters. There is no question of sport with him any more than there is with eels, as he only takes a dead line (chiefly a night line), so he would be dangerous in good waters; but, as a delicacy, there is nothing in fish to touch him. Had Vitellius only discovered the liver of burbots, he would have raised a temple to them; more there is no need to say.

As to the artificial breeding of coarse fish, I should like to see some more of it before I express an opinion. When you can get the spawn (as may be done with pike and perch, and probably also with carp, tench, and possibly roach), you may of course convey it to other waters in any way most convenient; but you must treat it naturally to an extent when there, for, though you may easily hatch it in tanks or aquaria, I have never been able to rear it. I think my friend Mr. Marston had a plan for hatching it in boxes, and these no doubt may be made useful and serve as a protection to the spawn; but I would not keep the fry in confinement. Put the boxes in some quiet back water, where there was enough change of water and stream, and let the fry find their way out, if they pleased. But there is a good deal still to be learnt in this matter, and I do not want to dogmatise; and I shall watch Mr. Marston's experiment with interest.

As regards the engines which are most dangerous to such fisheries, the drag net used in summer would not hurt much, as the weeds would protect the fish, but in winter, when the weeds are down, it would, of course, be very bad. A big cast net can work a lot of evil in skilful hands. The old powsing net was a destructive engine, and cleared out the pike and

perch most tremendously. It was set round bushes in a slight flood, or after a biggish one, and the bushes beaten, so as to make the fish come out and gill themselves. One of the worst and most destructive nets of all is the hoop net. I hear that the Conservators propose to license it, with drags and cast nets, to private fishery owners whoever they are. If they do, the Gordian fishery knot will be cut with a vengeance. In anything like a flood all the best fish go into the ditches; that will be into the hoop net. Towards the last fortnight of February all the pike get into the ditches to seek spawning places—that is, into the hoop nets. All I can say is, that if hoop nets are to be licensed, they should be barred after the 1st of January, or you will soon have no fish left in the river. The cast net, of course, must be limited, as it is a terrible weapon in the hands of an expert. Night lines, if allowed at all, should be regulated; so should all baskets or wheels for eels and lamperns. By the way, the Thames would be a capital river for the black bass, if anyone likes to try him there.

# CHAPTER IX.

## SALMON AND TROUT PASSES AND LADDERS.

Salmon and trout passes or ladders—some day when their construction and use is better and more widely understood—will play a much more important part in the economy of fish culture than they do now, and I may say something here on their use and construction. They are chiefly, of course, used for salmon, though there are plenty of cases in which they are very useful for trout.

There was at one time a run upon salmon ladders, and many were put up on various rivers; but unfortunately they were put up either by persons deficient in engineering skill, and devoid of a proper appreciation of the power and action of water, or utterly ignorant of the habits and ways of salmon. The result was that failure after failure occurred, and in some of these a large sum of money had sometimes been expended, and the mortification and loss caused by their failure often resulted in persons getting disgusted with the whole question, when they ought simply to have been disgusted with the person who planned the ladder. There are no two weirs and no two natural falls to which it is requisite to affix passes or ladders, which are alike, so that every weir must be dealt with on its own merits, and to know how to deal with it, the architect of the ladder should be thoroughly acquainted with the weir, in all weathers, waters, and times of the year. You want to know, too, how the salmon approach the weir, where they mostly congregate, and that both in winter and summer floods. How often I *have seen* a ladder built away out in the eddy part of the

weir, far apart from the main stream, and where the stream is lightest even in winter, and where, consequently, no salmon will trouble himself to come. Then, again, you see ladders or passes so contrived that the outlet from them runs in some twenty yards or more below the weir and that, too, with so moderate a stream that no salmon would stop for it, but would pass it and push on to the weir and the heavier water; and then, if you let a good strong stream down, enough to tempt the fish, the ladder is so narrow, and the chambers so small and badly constructed, perhaps, that the whole thing is all of a boil and torrent, and the fish cannot face it. Another fault committed is in making the ladder too short and the gradient too steep.

To be thoroughly successful, no *salmon* ladder should have a gradient steeper than 1 in 8, and that is risky, and 1 in 9 or 10 is far better. The chambers should not be less than 10ft. square (the wider and longer the better), so that the water supply is sufficient, because, the bigger the volume of water you can pass through the ladder without causing too great a turmoil, the more certain you are to attract the salmon into it. Weirs, as a rule, rarely run much above 10ft. or 11ft. high, consequently, to have a satisfactory gradient to such a weir, you should have a ladder 100ft. or so in length. A good deal of course depends upon the weir, and the width of the river, and the ground alongside of it. If the river is tolerably narrow, and the weir short, and the ground fairly level, it is comparatively easy to deal with, because you can make your ladder or cut pretty close to the foot of the weir, and carry it out round the end of the weir up into the river above, any distance up which you find most convenient; but, if it is one of those huge, wide, slantingdicular arrangements which are three or four times as long as the river is wide, and formed of a huge heap of rubble, over which even in a moderate flood you don't get more than two or three inches or so of water, it is a trying

case to deal with, the more so as you have to a certainty the miller to deal with too.

Such weirs for the most part have a long sloping down-stream face, and the stream when it does rise at all, comes over in trickles here and there. In such cases the only thing to do is to cut down the sill of the weir about a foot or eighteen inches at one part, and fix your ladder there; then have a sluice to it, which you will keep shut until the water, having risen, begins to flow over the whole weir. When the water begins to flow freely over the weir then pull up your sluice and let the stream through your ladder; and as long as there is any water running over the weir you are not using anything which is of any service to the miller, who is the great difficulty in all such matters. If you touch the sill of his weir, without his consent, he will *raise Cain,* as our Transatlantic friends say. Therefore, this arrangement is necessary to prevent any waste of what he calls his "milling powers." Indeed the miller may keep the key of the sluice, and only open it when the water reaches a certain height *on a carefully prepared and computed gauge,* an exceedingly necessary thing to have.

Of course it is impossible to say how you will fit a ladder or pass to any obstruction without seeing it. In this last case, of course, the main stream flowing over the weir will be that through the salmon ladder, unless it happens to be a very heavy flood indeed, when probably the fish will get over without the ladder.

On some sloping rubble weirs you can fix a diagonal board from the lowest place in the sill of the weir, slanting down to the foot, as in the preceding sketch of Bransford weir (see "Reports on Salmon Ladders"), but you must contrive to fix your diagonal very firmly or it will be carried away, and even then a few tons of ice are awkward passengers to deal with. Such a weir as this, however, would not require the board in a winter flood, and the board, therefore, might be

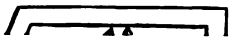
made to unship when winter approached, with struts on the lower face of the board to support it when in use. With an upright stone weir of eight or ten feet high, or a natural fall, you must either make a pass entering the river near the foot of the weir and going round the end, or you must build a reversed ladder like that of Ballysodare—what that is I will explain presently—or you must cut through the weir and project your ladder up stream. But with an ordinary weir of moderate height the common straight ladder will do well enough.

There is a very good one at Galway—the next sketch will show it. This weir is only 5ft. high, the ladder is 48ft. long, so that the incline is one in nine and a half, or thereabouts, and thousands of salmon pass up this ladder, which was constructed by Mr. Ashworth. The width of the ladder is 10ft. 2in. in the clear, the chambers are irregular in length; the upper one is 9ft., the second 9ft., the third 9ft. 7in., and the fourth 12ft. 7in. There is a fifth made by rough stones, as shown, in order to ease the fall into or rather out of the fourth. When there is a decent flow of water in the river it comes over the wall marked AA, and thus it forms a strong and very tempting stream to the salmon. When I saw it and made this sketch a dozen years ago there was very little water running. When the ladder is running fairly full, the water goes over most of the stops, which are 20in. high, and are, like all the rest of the ladder, made of stone. The breaks in the stops, through which the water is shown to be rushing, are 19in. wide; and, with 20in. depth of water and 12-foot pools, any salmon can get through with the greatest ease. The intake, where the water comes in, is 2ft. wide, and has been cut down some depth—some 2ft.—into the sill of the weir.* Of course, this is a special ladder,

* It was generally stated that if you cut into the sill of a weir you ran the risk of destroying the weir. It has not destroyed this one.

but unfortunately every ladder is more or less a special ladder, and we can only, in the restricted space at our command, deal generally with the question, and this ladder will give a general idea of how a ladder should be constructed. In this case there was, I have said, a strongish stream to attract the salmon, If there had not been it would have been requisite to bring the foot of the ladder nearer to the weir, and in that case it would need to be carried up stream instead of down, or to be of the Ballysodare pattern.

The Ballysodare ladders were placed on the river of that name in Sligo, where there were high natural falls. That at the Ballysodare fall is abrupt, and is nearly 20ft. high. A cut of it is given herewith. This river had no salmon in it until Col. Cooper, in 1856, built these ladders, and planted salmon in the river above; and in time these went to the sea and duly returned, taking the ladders quite naturally and easily, and from that time it has been a valuable salmon fishery. There are two other falls not quite so high further up the river, but one is more broken, and the other is more abrupt. The ground to some extent favoured the construction of this Ballysodare ladder, as will be seen. It discharges a fine stream near to the strongest water, and the fish run it without hesitation. It is from top to bottom 248ft. long, and the plan will show the dimensions of the chambers, and the section shows their construction; the water in the chambers stands at some 14in. or 15in. deep; the pools are 11ft. long on the upper section, and 12½ft. on the lower; the breaks in the steps are 13in. wide; there are sluices at the top, the gradient being nearly 1 in 13—very easy. Of course the river is represented here as almost dead low, it being in the midsummer when I took the sketch. The Colloony fall was more difficult, the ground being very high and rocky. The ladder had thus to be built up of masonry, not cut through the adjoining land. The fall is 17½ft. high. The other was less difficult. These



ladders, with compensations and other costs, cost Col. Cooper about 7000*l.*, and when I was there he was realising about 3000*l.* a year more or less out of the fishery. At least this was my estimate, selling his fish at 1*s.* a pound; but even if he made a good deal less, it was quite profitable enough. Wherever weirs are subject to rubbish or ice it is as well to fix an ice guard of triangular shape just above the mouth of the salmon ladder, or the steps get damaged. The first salmon ladder ever made was that at Deanston, on the Teith; it was made in 1834 by Mr. Smith. The weir was an easy one, and the steps were placed on it, but they have often been sorely damaged by ice. There are double steps from either side.

There is another method of negociating moderate falls or sloping weirs, and that is by putting a supplementary weir across the river, thirty or forty yards or so below the other, and about a foot or two in height. Now, the great difficulty which a fish has to contend with in getting over weirs is that the foot of the weir is nearly always so strongly paved with heavy stone that close up to the weir it is constantly exceedingly shallow. Now, a fish can jump or force himself up very heavy and high falls if only he can get a fair depth of water to make a start from. Look at the salmon at Ballyshannon falls. They will frequently jump 8ft. or 9ft. out of the water, and, catching the fall just where it is on the bend, with a sweep of the tail, they will rush up through another 2ft. or 3ft. of falling water, and get over the fall; but then there is a considerable depth of water below the fall. A fish cannot get over a two-foot fall if it has only some 6in. or so to start from at the foot of the weir. The plan of putting a second weir, therefore, makes a deeper pool at the foot of the weir, and it takes from the fall from 1ft. to 2ft. in height, and gives the fish a good depth to start from. Of course, it can only be done in small and moderate rivers. It often happens that a natural obstruction—as, for example, the falls

of Tummel—shuts out an enormous stretch of valuable spawning and rearing ground, and that, too, of poor ground, almost valueless for any other purpose. In these instances there can be no question that a suitable ladder, if such could be made, would pay for itself in increased production cent. per cent. In such cases, however, the fishery owners below the fall have to be compensated for the injury done to their fishery, and it is difficult to get people to discount a prospective gain by a heavy present payment. My notion, however, is that the right to make such a ladder should be rented, and an annual payment equivalent to the supposed estimated injury paid by the net fishers below who profited most by it. In this way I should think all such difficulties might easily be got over. All that is said as regards salmon here is equally applicable to trout, only of course on a smaller scale; and it must be borne in mind that though trout, particularly fish of 2lb. and upwards, will at spawning time force themselves up a very heavy shoot indeed in any mill waste, yet they are not as good jumpers as salmon.

There is one point that I have not noted in respect to salmon fisheries, and that is where the salmon lie and take in regard to salmon pools. Now it is, I think, pretty well known that if there is a big stone or a ledge in a pool, that is the place where a salmon will chose to lay and to take behind. "Just bring it round, Sir, and hang it a wee bittie over that big stone ye can just see the curl of. And there he is, Sir. I told ye so!" We've all heard that sort of thing dozens of times, and let not the hint be thrown away; and if you have got bad rising pools or pools the salmon do not freely frequent or rest in, try what tumbling two or three stones, about the size of loo-tables into the mid stream will do. I heard of a man protecting his pools from netting by floating large beer-barrels on to his pools with a few tenterhooks in them, and then filling them up with cement and concrete. They prevented netting and improved his fishing, and I am quite

sure that the plan would be an excellent one for the big Thames trout on the Thames.

A question has lately been mooted as to whether salmon are affected by noise. I don't think there can be a doubt that all fish are more or less affected by loud noises, which cause strong vibration of air, earth, or water. I know several pools or rivers which were formerly fine pools for the angler, and where salmon always rose well. Railways in one or two instances have been made along the margins of these pools, and the rumble and rattle of the trains has destroyed them for angling. In several instances where heavy artillery practice has been in use of late years on the sea coast, the fish have deserted that part of the coast. I know that Ronald tried the experiment of firing off a gun behind a fishing hut to see if it would affect a trout in the river. So far good; but I doubt if a gun under these circumstances would produce enough concussion or vibration to effect a sensation on the fish. The slightest shake of the bank, as we all know, would have seen the trout flying, and, whether mere noise is objectionable or no to the fish, Izaak Walton's advice is certainly to be remembered when he says you should "study to be quiet."

# APPENDIX.

NOTE 1.—It is not necessary to cite many special instances to prove that want of protection and regulations have done this mischief. There are a score or more of once noted localities round our coasts which once produced large supplies of the very finest fish, which are now comparatively fishless. The destruction of the small fry by all sorts of objectionable methods, and by the rescinding of the Act of George I., which regulated the takeable size of fish, has done this effectually, not only to our scale fish, but even to our shell fish, oysters being in the same condition or worse, and from precisely the same causes. Crabs and lobsters also were rapidly disappearing some years since, and if any proof were wanted of the absolute need of protective legislation in all our sea fisheries, the enormous increase of crabs and lobsters in the three years during which legislation has given them some slight protection on the Norfolk coast most abundantly and forcibly demonstrates.

NOTE 2.—The notion indulged in by most water keepers seems to be that to cut weeds now and then, look after hatches, and walk along the banks at other times is all they are called upon to do; it is a very big hallucination. If a keeper does his duty thoroughly, it is a calling requiring constant occupation. There is always something to be done to improve a shallow or bank, so as to foster the sport which

he is paid not only to protect, but to develope and improve as far as possible.

NOTE 3.—There are a great number of anglers who are less liberal in their estimates than they ought to be. A fish is a fish, and the value is "per brace," and not according to size or condition; and thus fish out of condition and undersized are constantly taken, even when no worse practices prevail. On all fisheries it ought to be a hard-and-fast rule that the keeper should look over the take of the angler whenever he comes across him, and in doing this he should not merely glance at the top fish or two in his creel, but see the lot; and this rule should be insisted on. Keepers don't like to do it because gentlemen may not like it; and if they do what gentlemen do not like they fear that backsheesh may suffer. The master's interest therefore suffers that the keepers may thrive. Now, no *gentleman* can object to abide by the rules of the water upon which he takes his fishing or obtains his leave. If he knows that it is the rule there is no hardship in it. The hardship is when it is only the exception. No one will object unless they are breaking the rules, and the sooner they are bowled out the better. I have seen fish taken over and over again not 10in. long when 12in. was the limit. As for ¾lb., which is a common limit, it is a good big fish that rules ¾lb., and fish of ½lb. and less, under this rule, far too often stand for ¾lb.

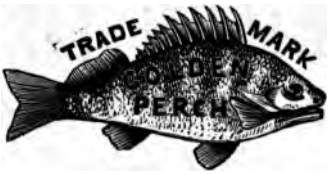
NOTE 4.—If the reader has never seen a flock of ducks when the Mayfly is in he would never believe the immense quantity of Mayflies a flock of ducks will devour. Where they are permitted they will take more than the fish in the same length. The flies flutter off the water on to the grass and sedges at the river bank, the ducks coast up and down all day long, picking them off as hard as they can, and no one would believe the quantity they gobble up. There is no

stream anywhere now which is over-stocked with Mayfly, and no stream that can afford to keep ducks on it. They are so fond of the food that, as with ova, you cannot drive them away. In fact, ducks should never be allowed on a trout stream at any time.

# ADDENDA.

At page 21 I mention that grannoms could easily be collected and sent to a distance to stock another water, but since I wrote that another idea has occurred to me. If the angler watches the rise of the grannom he will find, on one or two afternoons, that the fly is burdened with a huge lump of eggs, fully developed. This lump is almost as big as the rest of the fly's body, and it is a sac full of many eggs, quite fit and ready for laying, and often when you take a fly in your hands it drops off and remains in your hand. It might not be at all difficult to collect any number of these sacs of eggs in a small can of water, and, carrying them to the place to be stocked, to turn them down amongst the stones in some safe place. This, I think, is a much easier and simpler plan than the other.

# THE GOLDEN PERCH.

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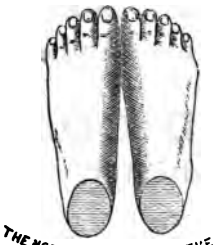

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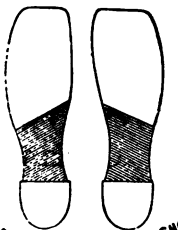

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